

Compatibility between consumer surplus based values and real income

Dr. Burkhard Schweppe-Kraft
Unit on Legal Affairs and Economics



Focus of this presentation

- One detail that Geir Asheim pointed out in his presentation is the fact that real GDP would be a good indicator for welfare if all elements of real income are taken into account and a divisia price index is used for correcting nominal income for inflation.
- My slides take up this point and focus on the issue of comparability between welfare valuations on the basis of consumer surplus and real income if the usual price indexes are used.
- The result: welfare valuation on the basis of consumer surplus is in most relevant cases compatible with the usual real GDP measures. Wherever there is no direct compatibility, appropriate adjustment factors can be defined with the help of the presented methodology.

The problem behind: Exchange values or benefits

- Benefits measured by consumer surplus are the basis for many approaches to value ecosystem services (esp. for cultural services). But consumer surplus is excluded from the accounts by the SNA-rules.
- Generally only the use of exchange values is allowed in accounts and it is said that exchange values must not be mixed up with consumer surplus because of inconsistencies.
- Exchange values can be simulated on the basis of marginal utility curves (simulated demand curves) and then be integrated into the accounts. But using this kind of method can end up in serious communication problems.

The communication challenge: Can people interpret accounting values in a proper way?

- Whenever the price elasticity for ecosystem services is above -1, an increase in ecosystem service supply leads to a decrease of the value of simulated sales.
- Integrating ecosystems into the accounting system might be a good idea. But arguing successfully for conserving and rehabilitating ecosystems and their services would get difficult if an ecosystem service increase leads to a loss of value in the accounts.
- It can be assumed that, more or less, only economists are aware that decreasing marginal values and simulated sales due to additional supply mean the opposite of what it looks like, namely not a decreasing but a rising contribution of ecosystem services to welfare and what Geir Asheim told „comprehensive“ or „green“ income.

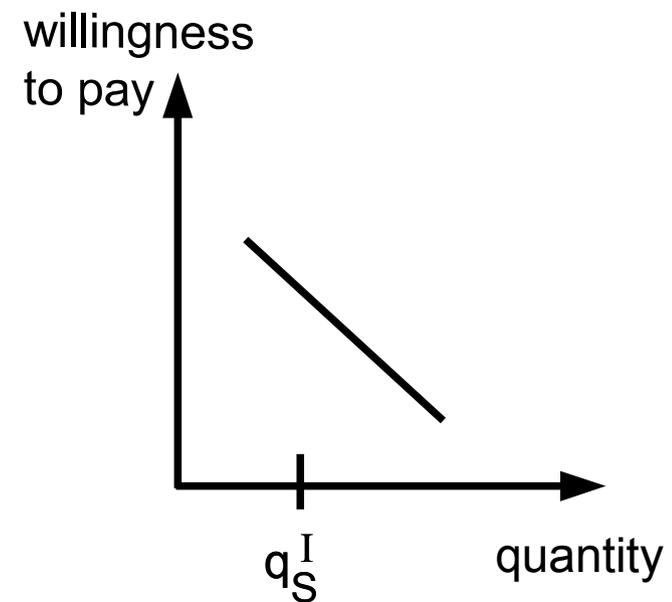
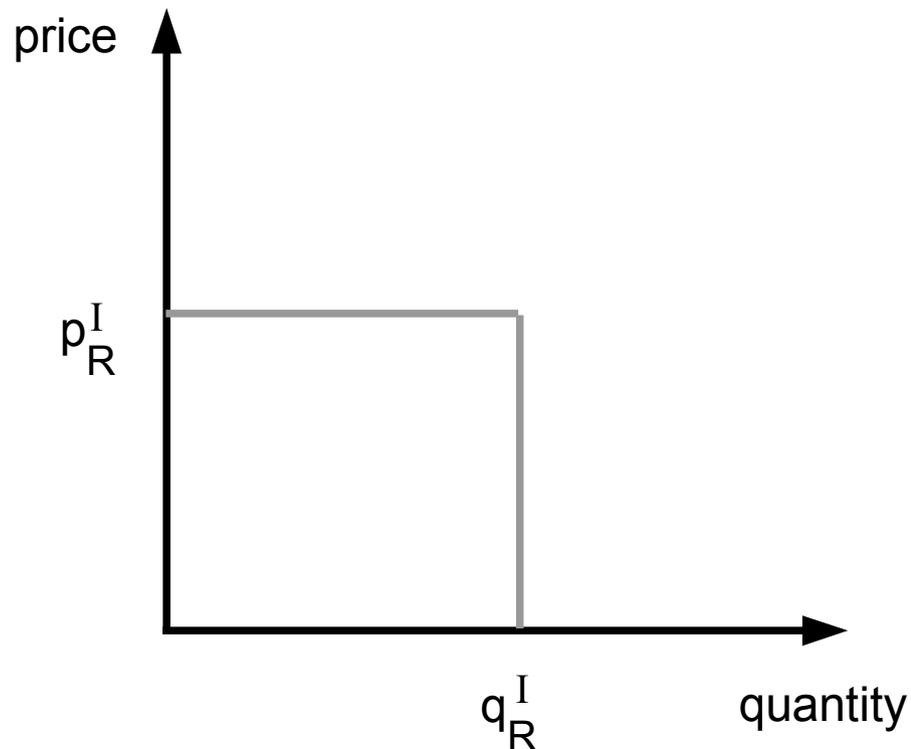
A solution: Take consumer surplus calculations for communication. They are compatible with real GDP!

- A GDP-deflator like the Laspeyres-, the Paasche- or the Fisher-Index is far more than just a tool to correct nominal GDP for inflation.
- These kind of deflators work with the quantities and the prices of goods in a way that is - in the end - very similar to the calculation of welfare changes.
- The degree of similarity between applying those deflators to nominal GDP and welfare accounting is so high that welfare gains and welfare losses calculated on the basis of welfare economic methods can be, in the most cases directly or with only minor adjustments be compared with changes of real income.
- The similarity between the two measures, welfare calculations and real income, is demonstrated with the help of a simple two-sector model of the economy. The results, however, are applicable also to multi-sectoral real economies.

The two sector model: Ecosystem services and the rest of economy

good „R“
„Rest of the economy“

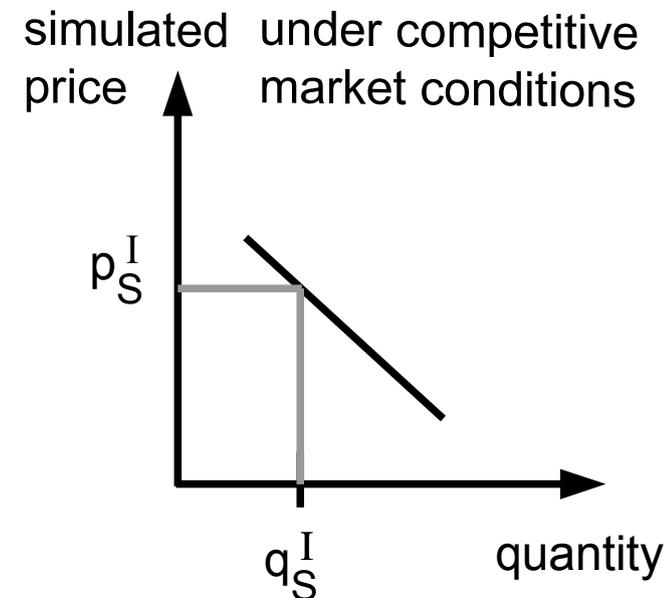
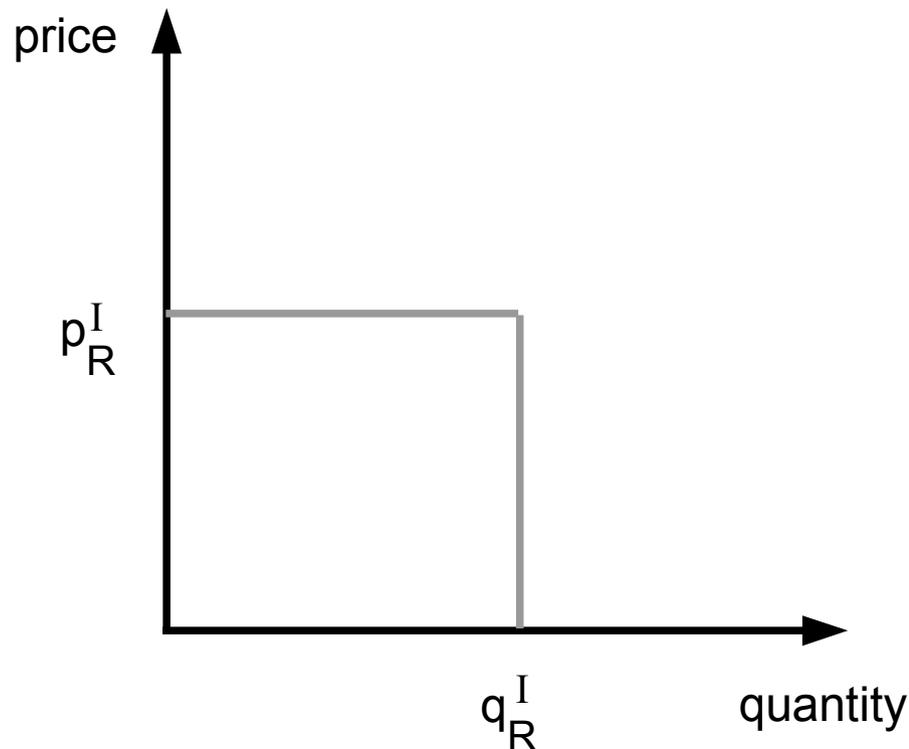
good „S“
„Ecosystem services“



The one way of measuring economic values: Simulated efficiency prices

good „R“
„Rest of the economy“

good „S“
„Ecosystem services“

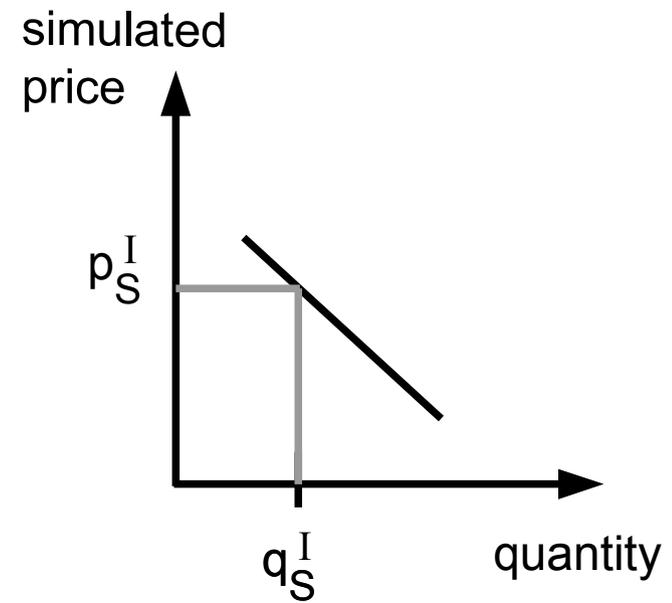
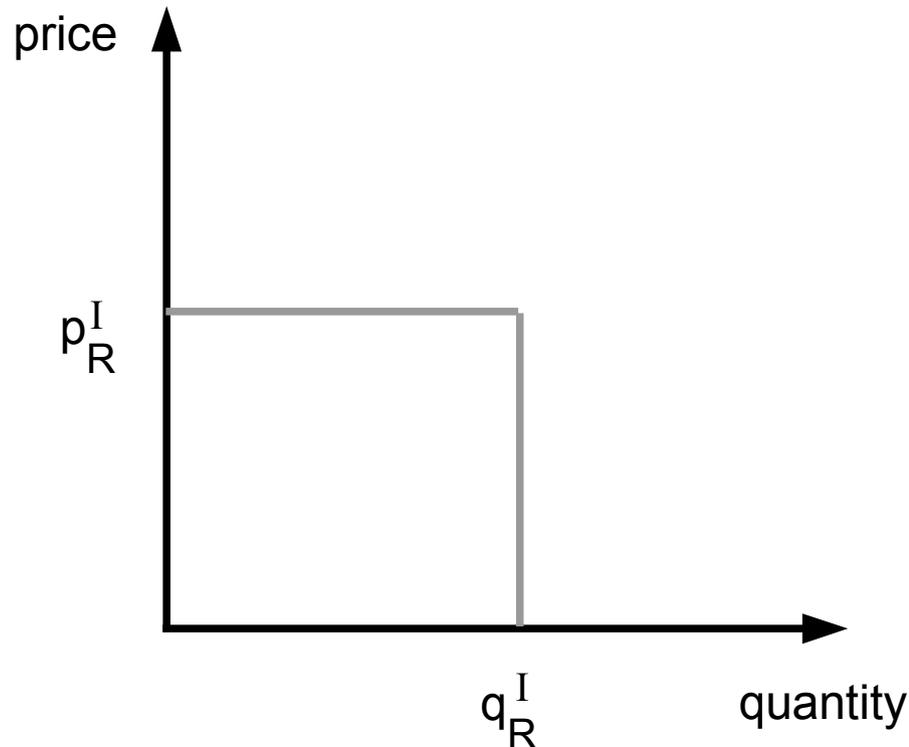


Calculated for year I

good „R“
„Rest of the economy“

good „S“
„Ecosystem services“

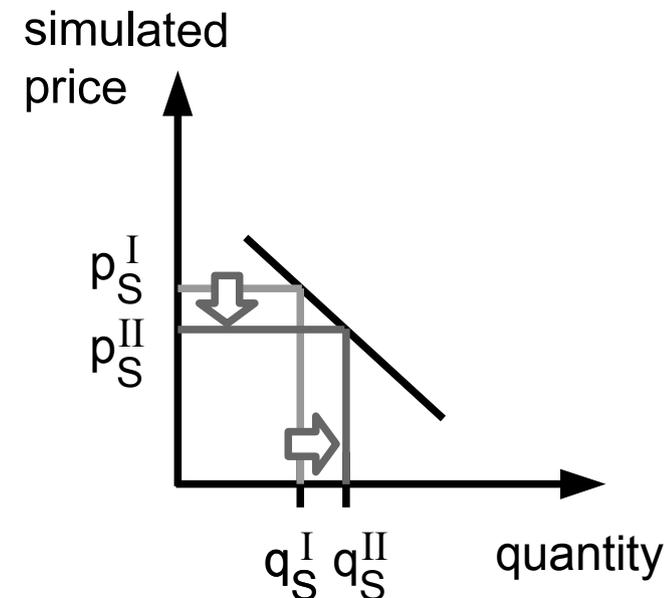
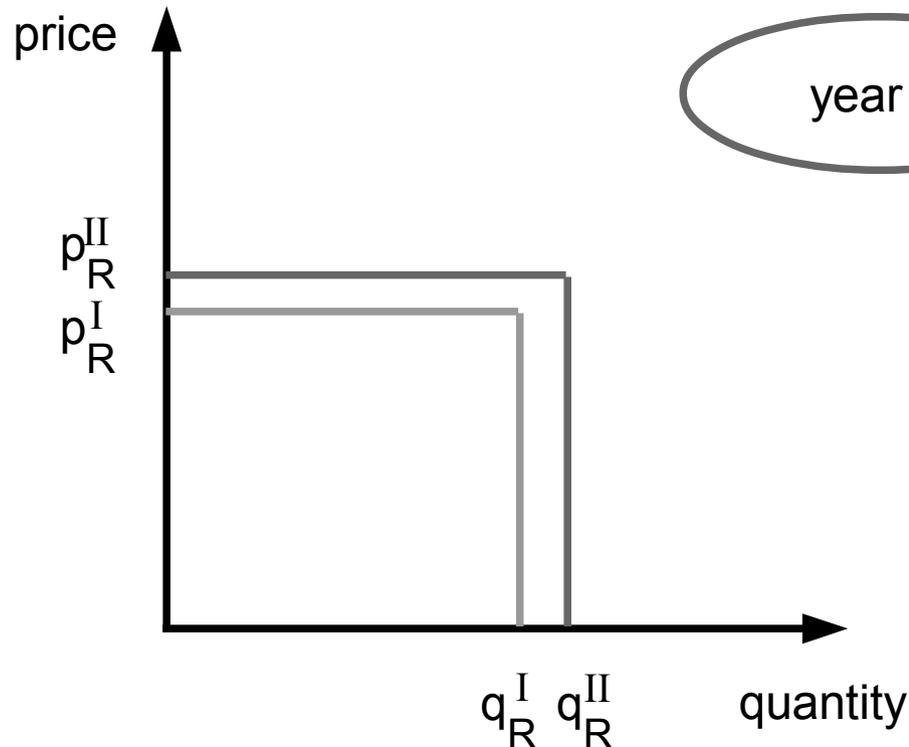
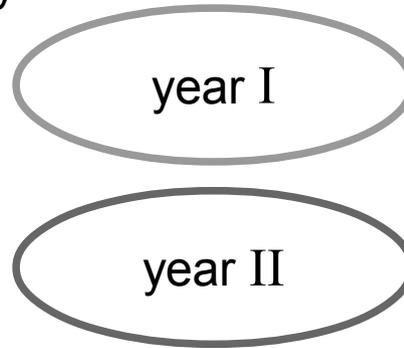
year I



And for year II, including growth and inflation in the „rest of the economy“

good „R“
„Rest of the economy“

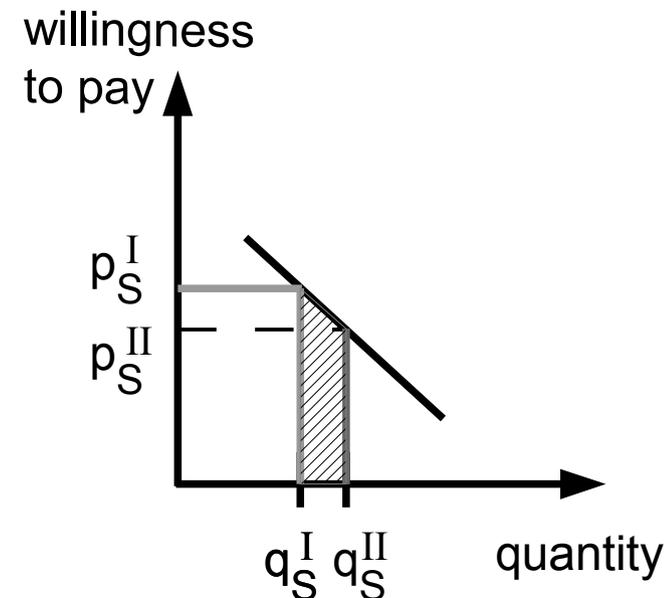
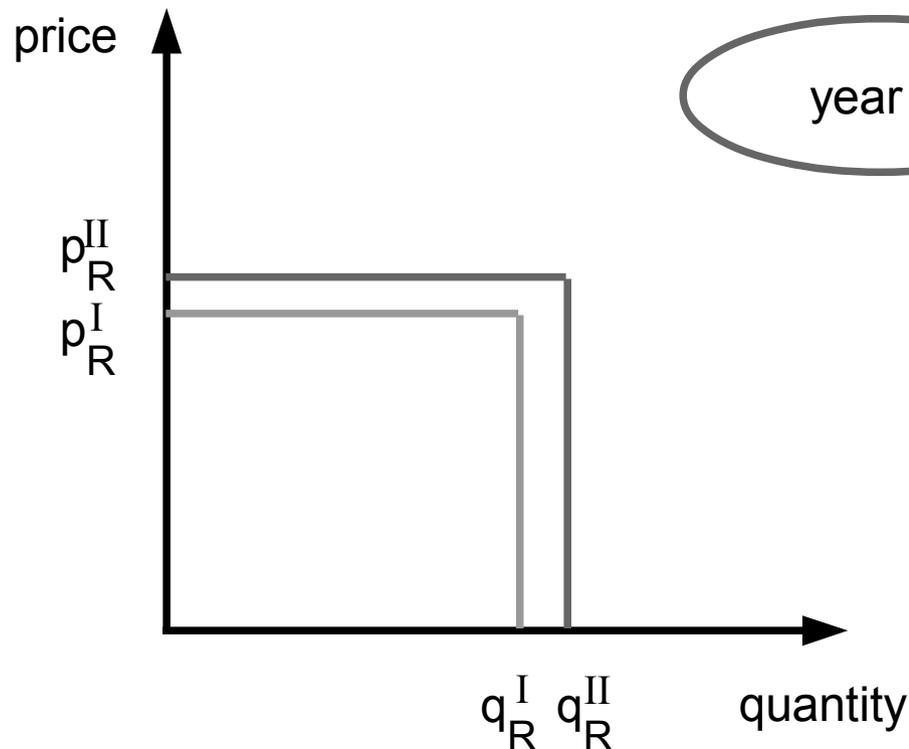
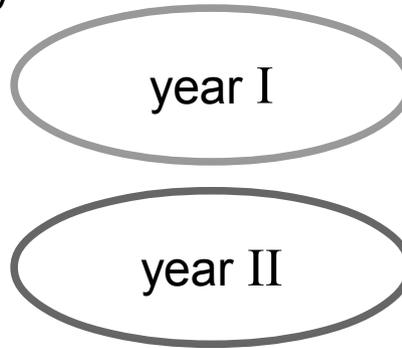
good „S“
„Ecosystem services“



Compared with the welfare change calculated on consumer surplus change

good „R“
„Rest of the economy“

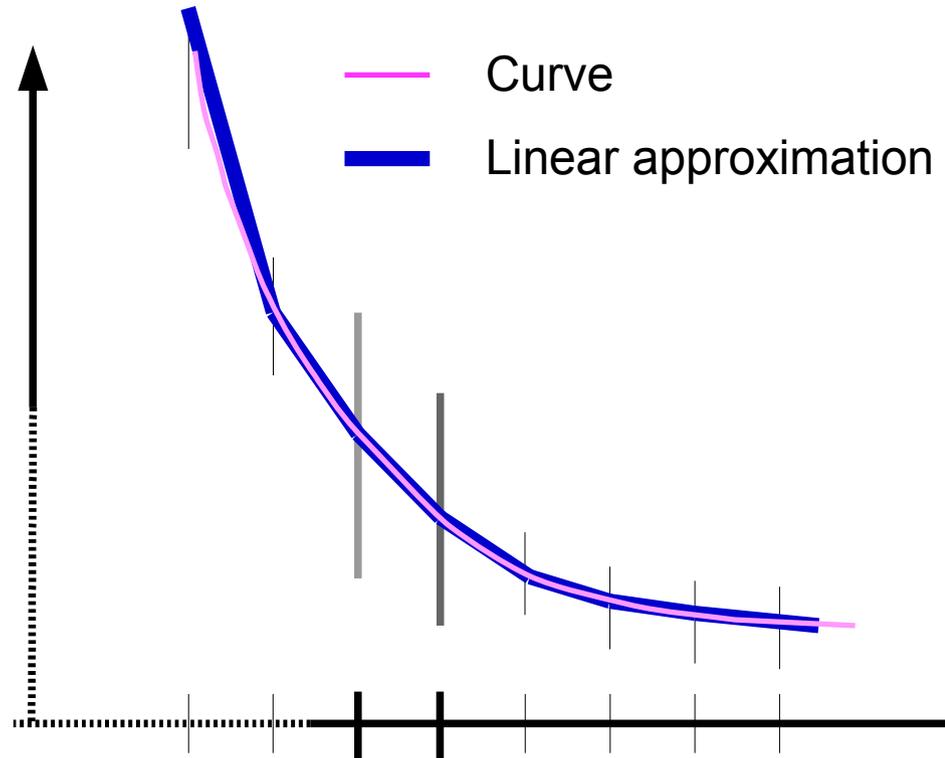
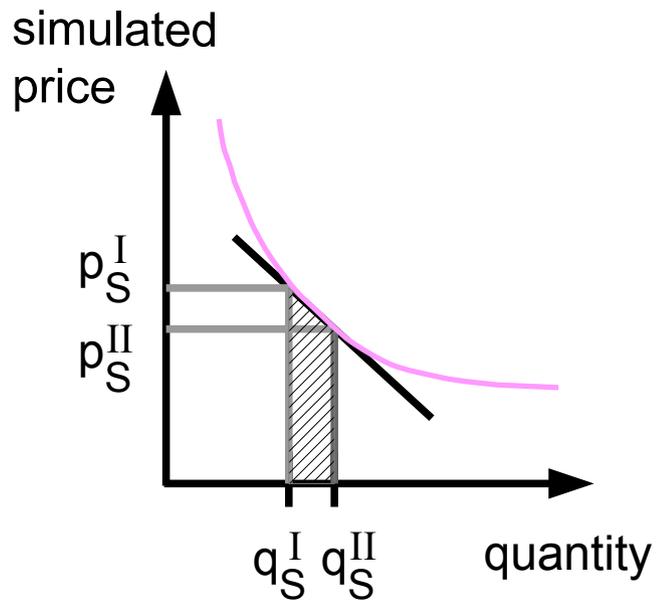
good „S“
„Ecosystem services“



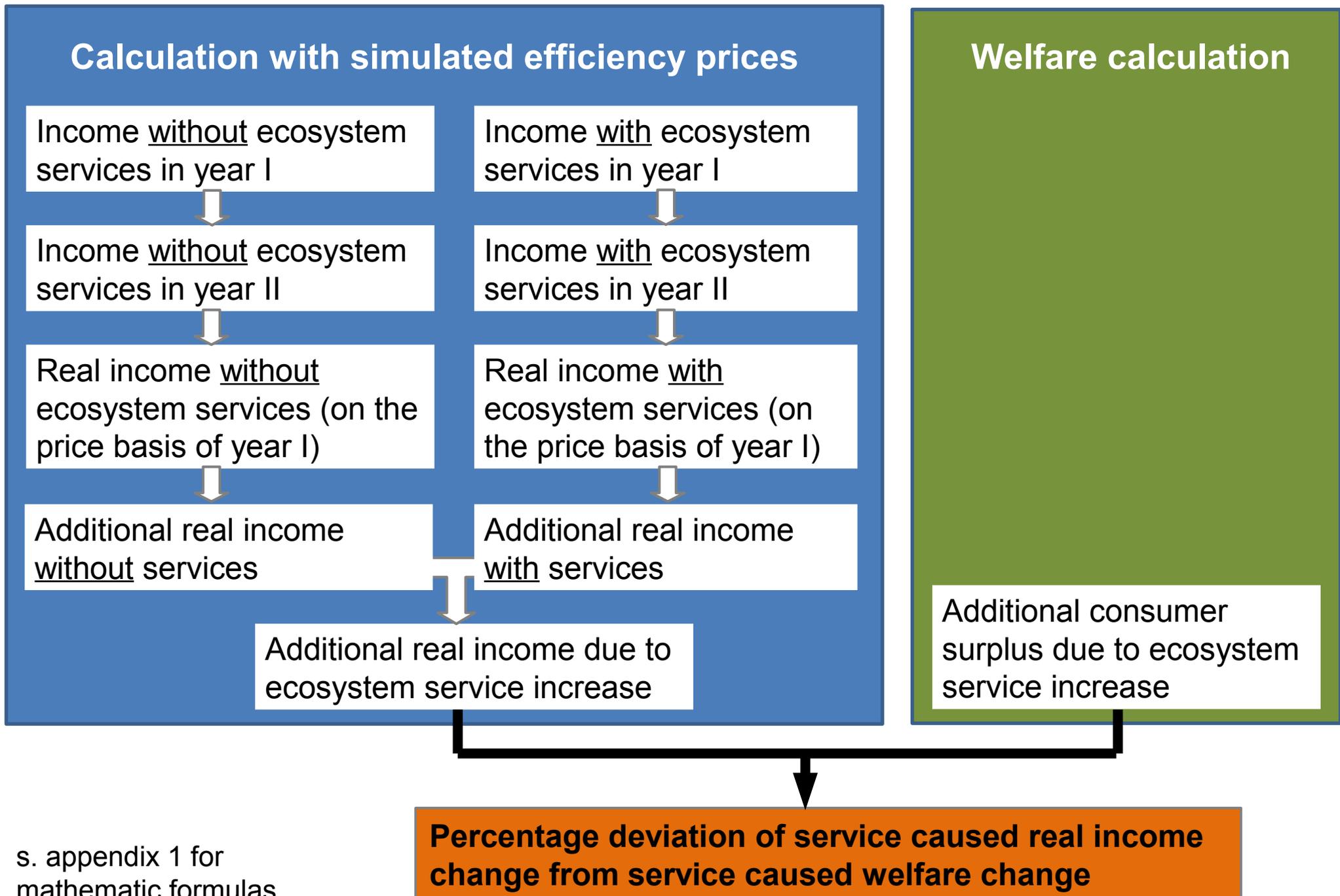
Assumption of a linear demand curve

Non-linear demand curves can be approximated by curves that consist of linear sections.

The assumption of a non-linear demand curves would change results only marginally.



Calculation steps – „with and without“ approach*



s. appendix 1 for
mathematic formulas

What meant the asterisk (*) in the last heading?

The Laspeyres price index is not completely consistent with the “with and without” approach”.

I come back to it.

s. also appendix 2
for further explanation

Parameters used for the different calculations

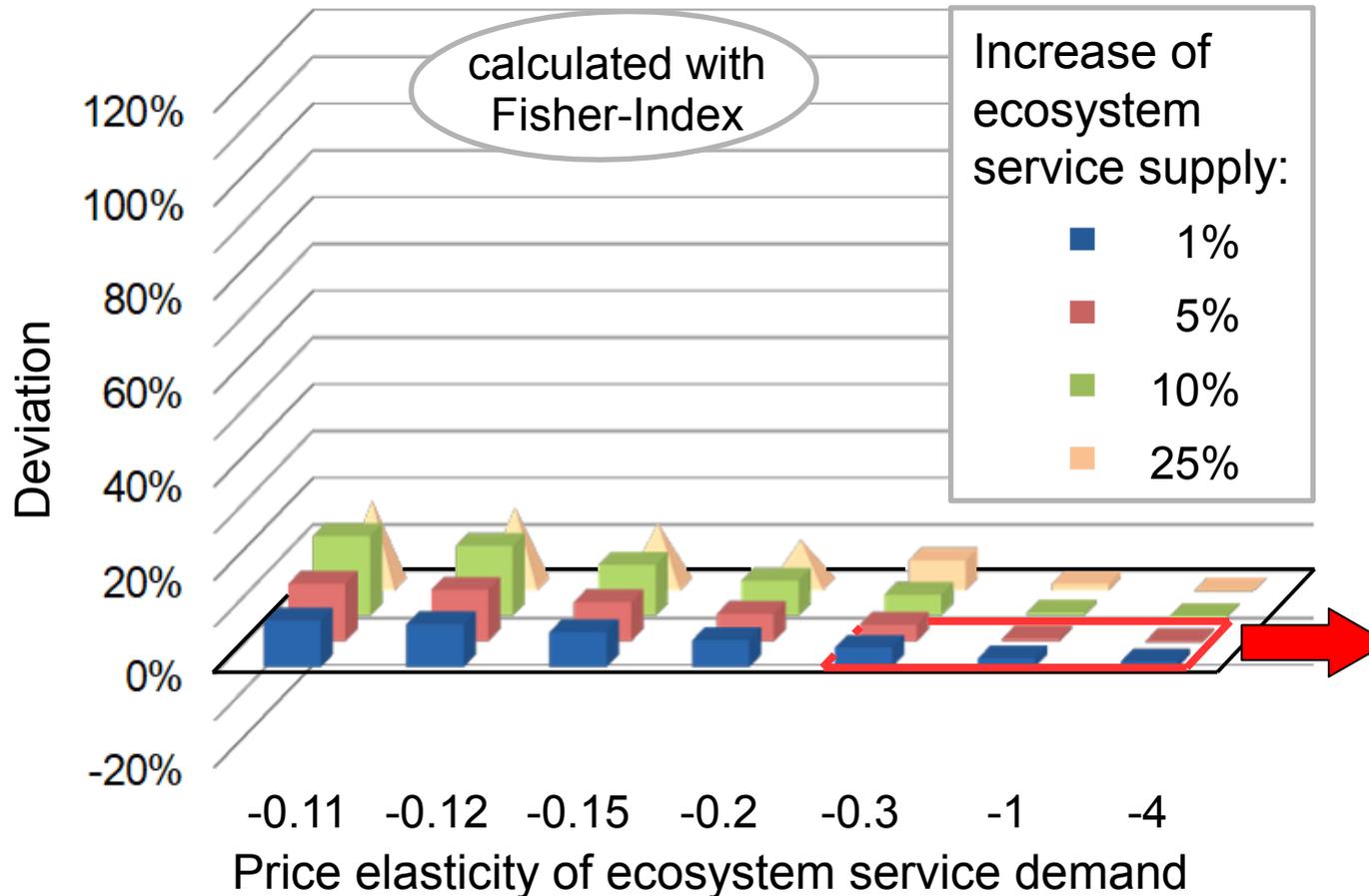
The deviation between the both approaches was calculated for the following conditions:

- size of the ecosystem service sector ($\frac{\text{simulated service sales}}{\text{overall income}}$) = 1%; 10%; 20%
- ecosystem service increase = 1%; 5%; 10%; 25%
- price elasticity of service demand = -0,11; -0,12; -0,15; -0,2; -0,3; -1; -4
(percentage increase of demand due to a 1% price release)
- price indexes = Laspeyres (overestimating inflation); Paasche (underestimating inflation); Fisher (geometric mean of Laspeyres and Paasche)
- Inflation and growth rate of the “Rest of the economy”, both = 1%; 2%; 4%

Additionally it was tested, whether the number of sectors has any influence on the results.

Results: Difference between real income change and welfare change when a Fisher Index is applied

Deviation of service induced real income change from service induced welfare change



Share of the ecosystem service sector: 10%;
inflation and growth rate of the „rest of the economy“ = both 2%

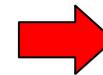
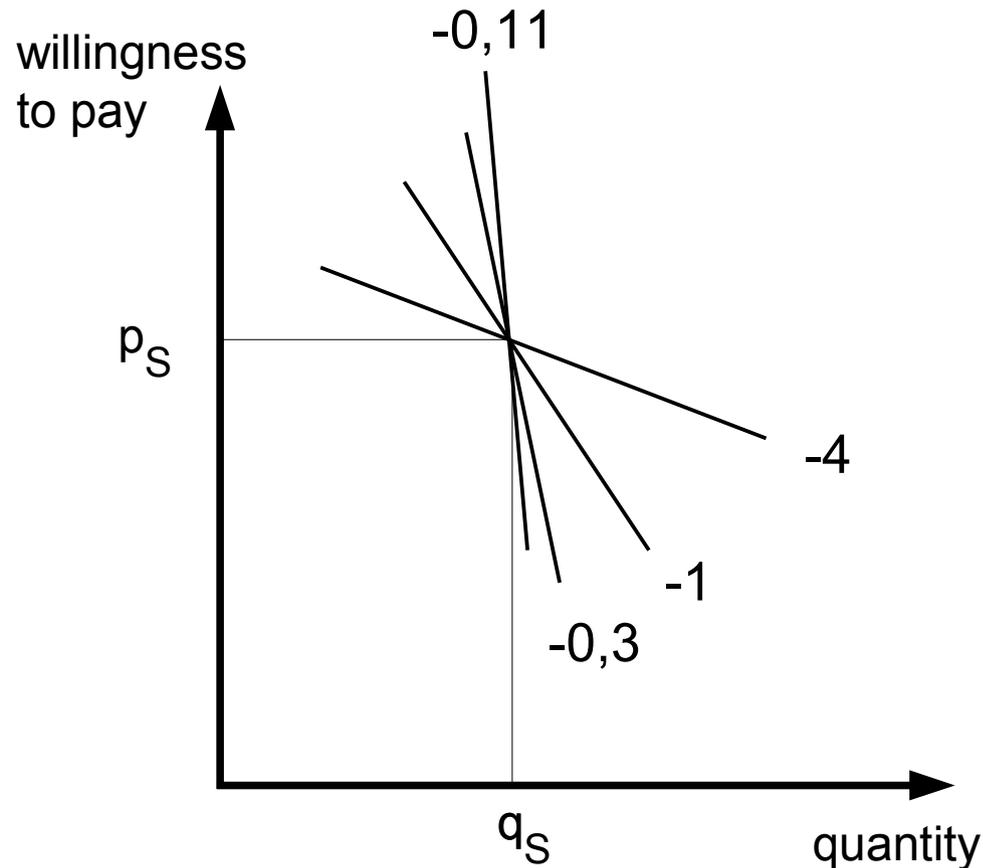
In the most frequent and relevant cases (minor quantity changes < 5%; price elasticity of demand < -0,3) the deviation between welfare and accounting measures is below 4,1%.



When quantity exceeds saturation point: price is set to zero, quantity is set to saturation point

For illustration: Price elasticities

Different price elasticities of ecosystem service demand

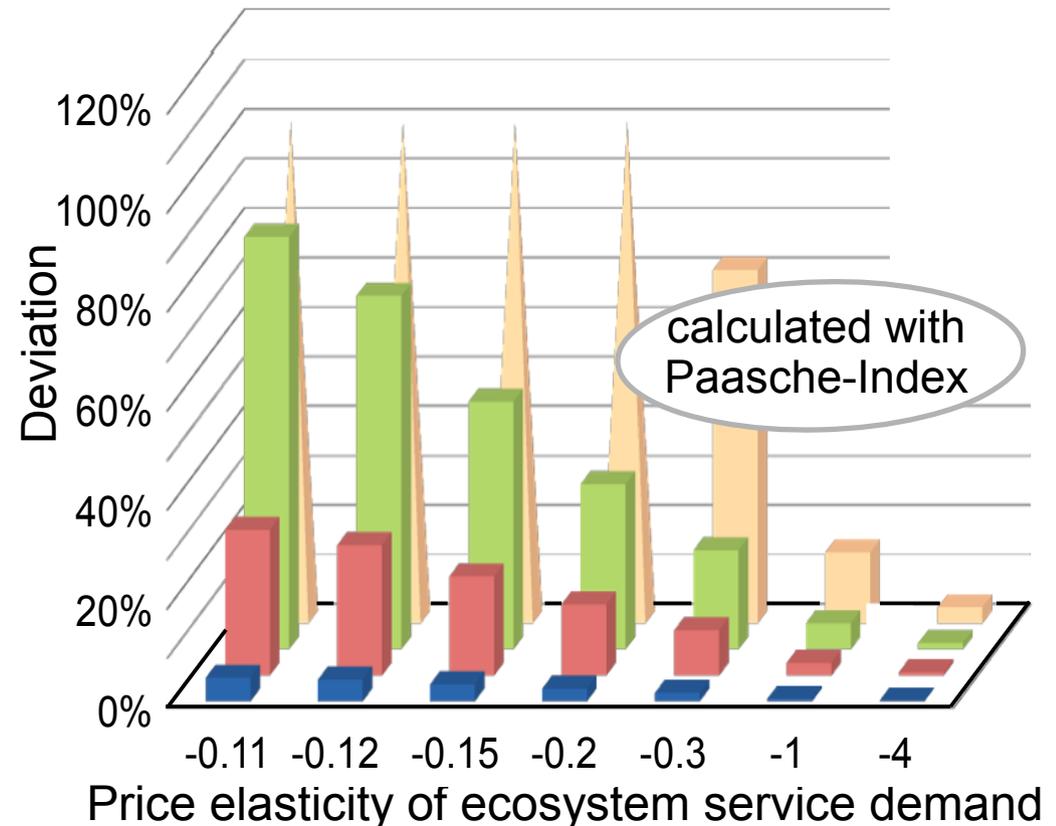
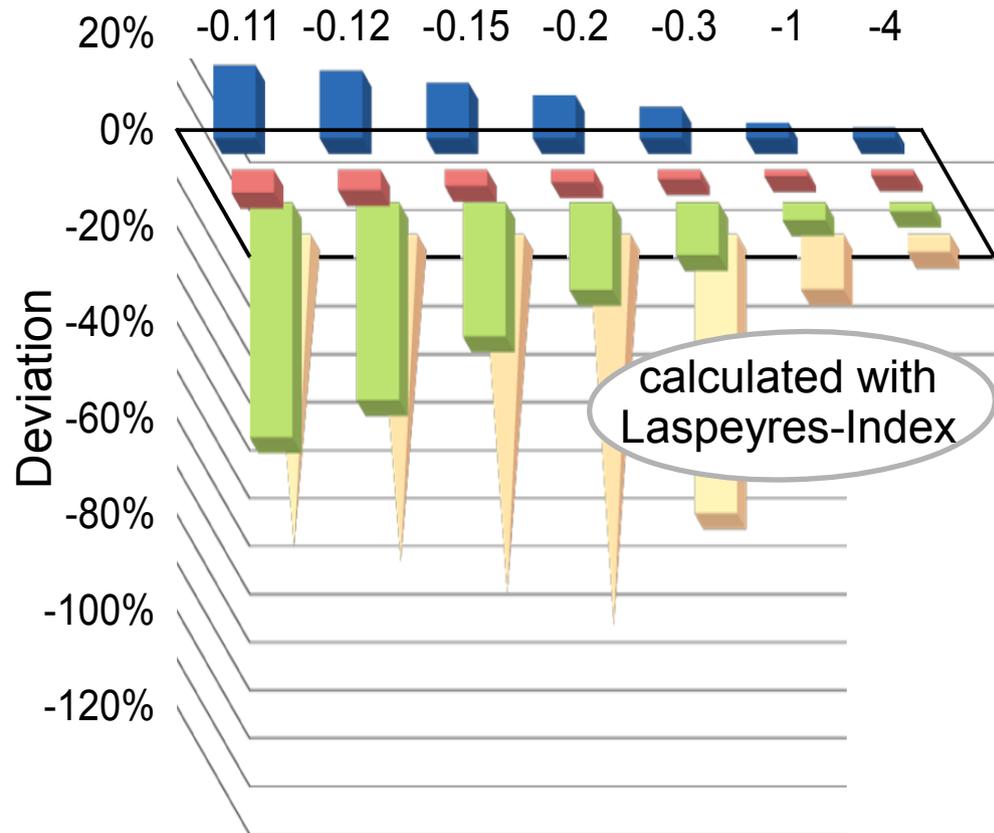


In cases where welfare and accounting measures differ most from each other (low price elasticity of demand) an increase of ecosystem services has only minor welfare effects.

Difference between real income change and welfare change if Laspeyres and Paasche are applied

Deviation of service induced real income change from service induced welfare change
(share of service sector 10%; inflation and growth rate of the „rest of the economy“ = both 2%)

Price elasticity of ecosystem service demand



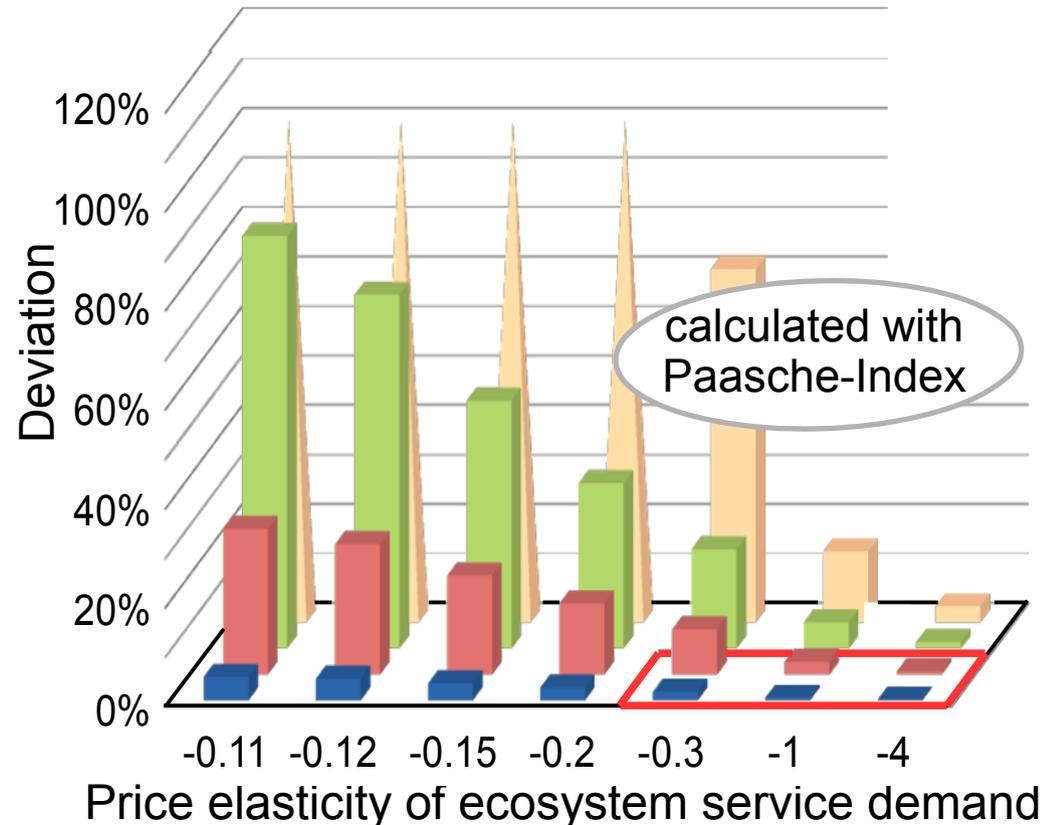
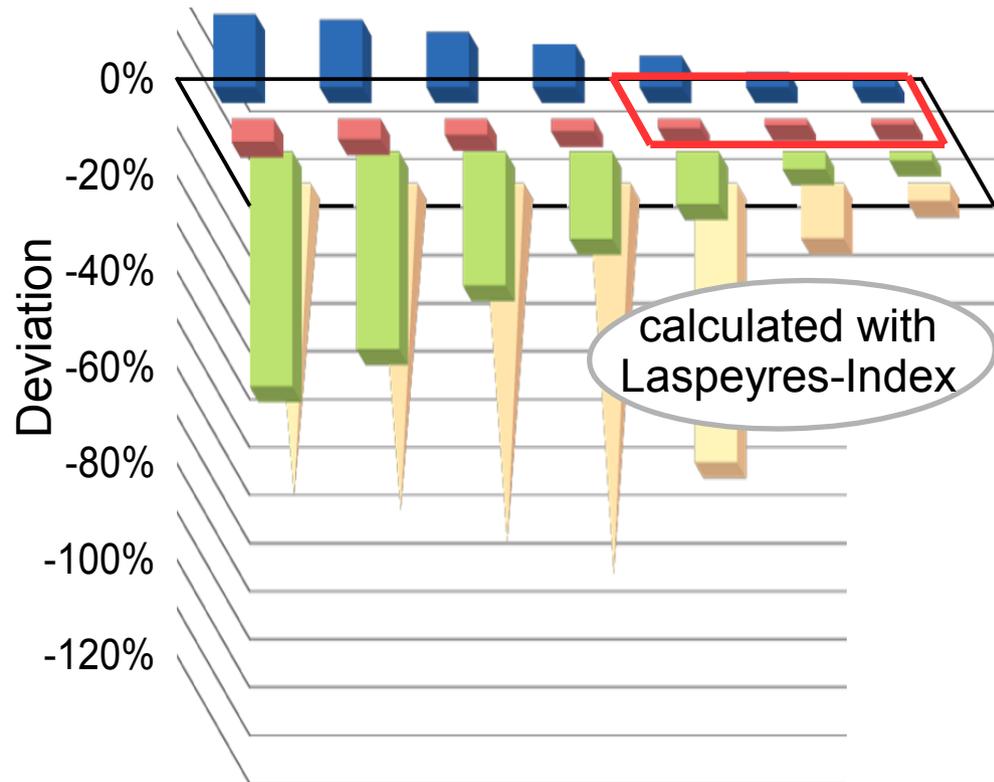
Increase of ecosystem service supply: ■ 1% ■ 5% ■ 10% ■ 25%

Difference between real income change and welfare change if Laspeyres and Paasche are applied

Deviation of service induced real income change from service induced welfare change
(share of service sector 10%; inflation and growth rate of the „rest of the economy“ = both 2%)

Price elasticity of ecosystem service demand

20% -0.11 -0.12 -0.15 -0.2 -0.3 -1 -4



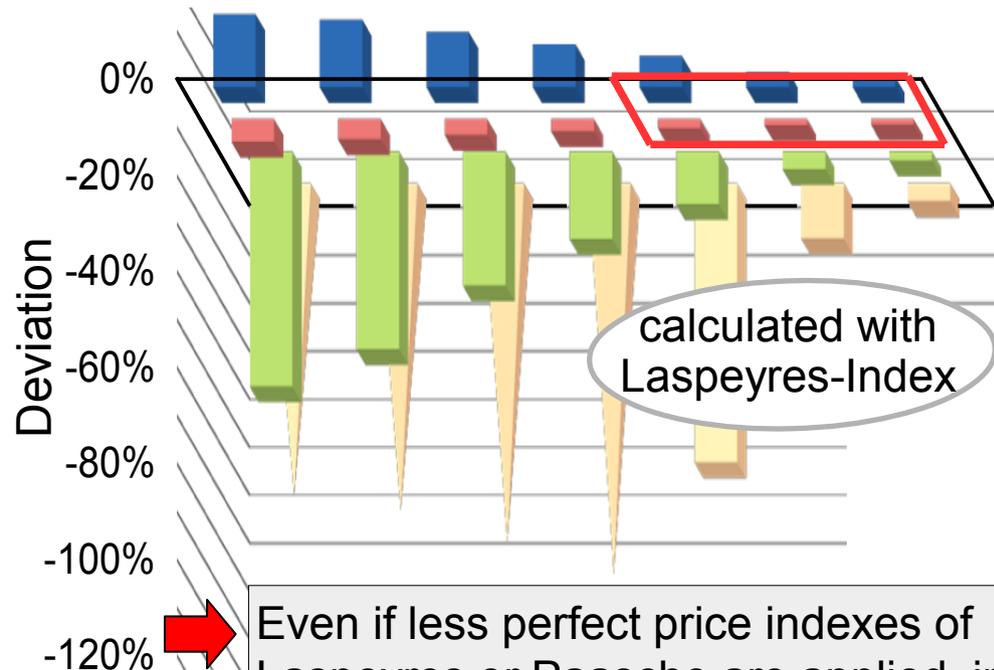
Increase of ecosystem service supply: ■ 1% ■ 5% ■ 10% ■ 25%

Difference between real income change and welfare change if Laspeyres and Paasche are applied

Deviation of service induced real income change from service induced welfare change
(share of service sector 10%; inflation and growth rate of the „rest of the economy“ = both 2%)

Price elasticity of ecosystem service demand

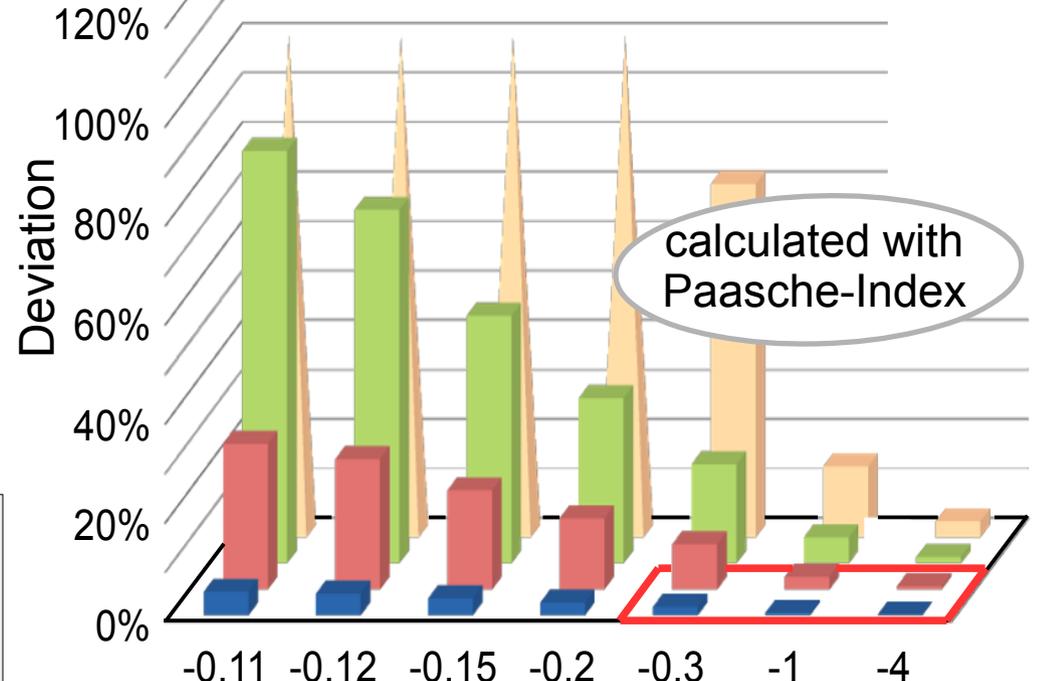
20% -0.11 -0.12 -0.15 -0.2 -0.3 -1 -4



Even if less perfect price indexes of Laspeyres or Paasche are applied, in the relevant cases the deviations are still between just 14,3% and -2,5%.



In less relevant cases of high price elasticity and service change the deviations reach up to 100%, so that welfare measures have to be adjusted before used in accounting.



Price elasticity of ecosystem service demand

Increase of ecosystem service supply: ■ 1% ■ 5% ■ 10% ■ 25%

Effects of the other parameters

- ➔ Higher (lower) growth rates of the “rest of the economy” have an increasing (decreasing) effect on the deviation between accounting and welfare measures only if Paasche or Laspeyres index is applied. With Fisher the deviations shown in the last slides keep the same.
- ➔ If the change of ecosystem service supply is below about twice the growth rate, then the use of Laspeyres, due to inherent inconsistencies of this index (see appendix 2), leads to an overestimation of the welfare change. In such cases we should be honest and use only the lower results of the welfare measures to express real income change.
- ➔ Higher (lower) inflation has also an increasing (decreasing), but very small, effect if Paasche or Laspeyres index is applied. With Fisher, again, everything keeps the same.
- ➔ Adding another sector to the model does not change the results. This means that the results of the two sector model are valid for any other multi-sector model of the economy.

Conclusions

The calculations shown in the slides point out, what could have been known since the article published by Asheim and Weitzman in 2001:

- If its intended to highlight and communicate welfare changes due to ecosystem service supply, then real GDP is an appropriate place for it.
- Welfare measures and changes in real GDP are in a large extent compatible.
- For the special cases where substantial deviations are likely, adjustment factors can be defined.

Recommendations for accounting

Alternative solutions:

Alternative 1: Integrate ecosystems services on the basis of efficiency prices (= marginal values) into nominal accounts and use welfare measures (which show \pm the contribution of ecosystem services to real GDP-change) to communicate the value of ecosystem service changes to society.

If it is decided, not to split off calculation for accounting from values for communication then

Alternative 2: Assume a market condition (“institutional setting”) that is consistent with the aim of efficient allocation and also delivers – in the end – the correct values for real GDP changes that are compatible with welfare changes according to the above findings.

Such a setting is the assumption that ecosystem service suppliers act as perfectly price discriminating monopolists.

With regard to real GDP both strategies have the same result: An increase in services contributes in both strategies with the same value and always positively to real GDP. Differences exist with regard to the value of the complete service supply within nominal GDP. If (2) is applied, the overall “sales” of a service have always a higher value than in (1). They never fall due to an service increase.

**Thank you very much
for your kind attention!**



Appendix 1: mathematic formulae for: Calculation steps – „with and without“ approach

Calculation with simulated efficiency prices

$$Y_R^I = p_R^I * q_R^I$$

$$Y_{R+S}^I = p_R^I * q_R^I + p_S^I * q_S^I$$

$$Y_R^{II} = p_R^{II} * q_R^{II}$$

$$Y_{R+S}^{II} = p_R^{II} * q_R^{II} + p_S^{II} * q_S^{II}$$

$$Y_R^{r, II} \text{ (base I)}$$

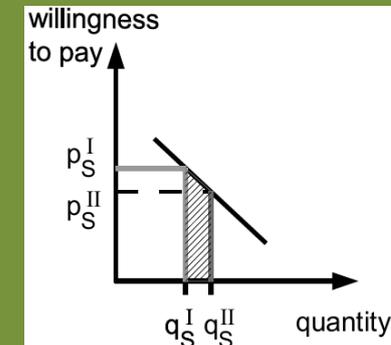
$$Y_{R+S}^{r, II} \text{ (base I)}$$

$$\Delta Y_R^r = Y_R^{r, II} - Y_R^I$$

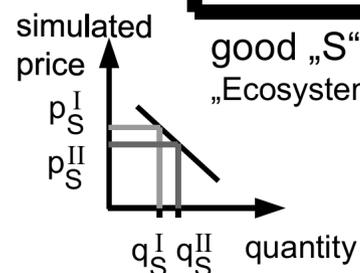
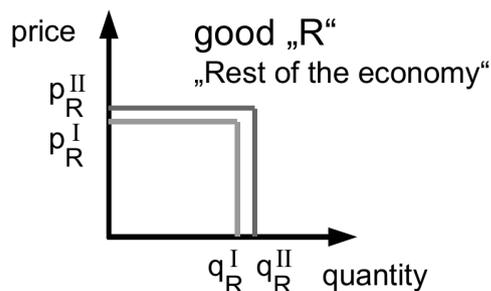
$$\Delta Y_{R+S}^r = Y_{R+S}^{r, II} - Y_{R+S}^I$$

$$\Delta Y^r \text{ caused by growth of } q_S = \Delta Y_{R+S}^r - \Delta Y_R^r$$

Welfare calculation



$$\Delta W = (q_S^{II} - q_S^I) * [p_S^{II} + (p_S^I - p_S^{II}) / 2]$$



$$\left(\frac{\Delta Y_{R+S}^r - \Delta Y_R^r}{\Delta W} - 1 \right) * 100$$

Appendix 2: Inconstancy of Laspeyres index

	only good R		good R and good S		
	good R	total	good R	good S	total
- year I -					
quantity	100		100	10	
price	2		2	2	
sales / income	200	200	200	20	220
real income					
- year II -					
quantity	102		102	10	
price	2,02		2,02	2	
sales / income	206,04	206,04	206,04	20	226,04
Laspeyres index		1,01			1,0090
real income		204			224,0036
- change -					
real income change		4			4,0036

Adding another sector that shows no growth results in an increase of the calculated growth of real income when Laspeyres index is applied!