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Summary of the Swedish debate on the discount rate

TRAFIKVERKET
SWEDISH TRANSPORT ADMINISTRATION

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Swedish Transport Administration

Summary of the Swedish debate on the discount rate

ASEK

- The Working-group for CBA (principles and values) in the transport sector

- Put forward recommendations regarding principles and values to be used in the transport sector. For the first time in 1991 (ASEK1)

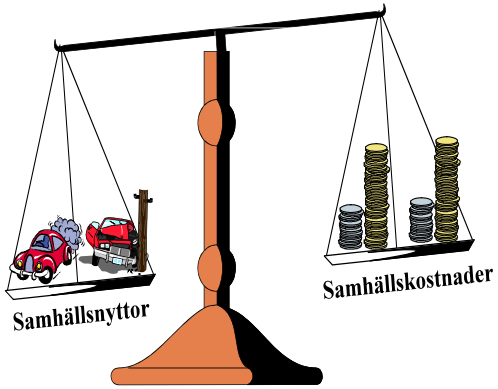
- Revisions every year. Major ones every 3 rd or 4th year and minor ones the other years.

- At present – the recommendations of ASEK5 (from 2012), revised to version 5.1 (2014)

- published on the web site of the Swedish Transport Administration **www.trafikverket.se/ASEK**

Scientific Results

- The ASEK recommendations has to be based on scientific results or well-tried and commonly accepted procedures and facts. Suggested ASEK recommendations are usually based subjected to second opinions from scientific experts before they are passed (or rejected).



What discount rate should be used? Discussion continues!

- Discount rate at CBA in Sweden and several other countries have fallen in recent years but that position has been challenged - again!
- From market rates to social discount rates
- Risk-free or risk premium?
- Risk-adjusted social discount rates?
- Project risks
- Disaster Risks
- Systematic risk - can not be diversified away

before 1991 and ASEK 1

- In the mid-1980s Sweden lowered the discount rate for infrastructure projects from 8% to 5%.
- Responsible ministry recommended the effective yield on equity investments as an approximation in the transport sector.

1994 review

- resulted in another reduction in the discount rate from 5 to 4 percent.
- The former risk premium approach was abandoned in favor of a pure social time preference
- it was considered a reduction to 4 percent was ”a move in the right direction”.

1999 - 2002 ASEK 2 och 3 – disputes but no more changes

One view: - an economic assessment should be based on households' time preferences

- one can assume that the inflation-adjusted interest rates of low-risk investments reflect households' marginal rate of substitution
- one can argue for an interest rate down to and below 2 percent because that about the inflation-adjusted return on government bonds after tax (in May 2002)

Another view: - one should also compensate for uncertainty in the discount rate.

Counter argument: - uncertainty should be handled for each investment opportunity, so close to the source of the uncertainty as possible.

1999 - 2002 ASEK 2 och 3 – disputes but no more changes

Data from 2002

- Goverments lending to banks - 4.25 per cent (2014 zero percent!)
- Government borrowing rate - 5.6 percent
- Yearly inflation - 2.5 percent
- 4.25 - 2.5 = 1,75
- 5.6 – 2.5 = 3.1
- Real interest rate was between 1.8 and 3.1 percent

- **Sweden decided twice to maintaine the discount rate as a risk-free interest rate of 4 percent.**
- But it meant in reality there was also risk premium of about 1 – 2 percent !

ASEK 4 - 2008

- Stated again that there is an important difference between financial discount rate used for financial projects and the social discount rate used in the economic calculations about public investments.

- Financial discount rate refers to opportunity cost of capital, ie the maximum return on capital from alternative investments. Opportunity cost is based on market interest rates, which in turn are based on **lenders 'and borrowers' preferences**

- The social discount rate determined by the time preferences and is thus based on i/ **pure time preferences**, ii/ **how fast consumption is growing** and iii/ **how fast benefits then falls when consumption increases**.

Using the Ramsey rule:

The economic time preferences

$i = z + n \times g$

- z = rate of pure time preference *(d);* people's impatience (benefit today is better than benefit tomorrow) and disaster risk (L); examples disaster risk are advances in technology that lead to the investment becomes obsolete prematurely, natural disasters and major wars.
- n = percentage reduction of incremental benefit from each percent increase in consumption (the elasticity of marginal utility of consumption)
- g = the growth rate of real per capita consumption

Net Present value is calculated using the following formula:

Present value Cost $$NuvärdeKostnad = \sum_{t=0}^{T} C_t \times \frac{1}{(1+r)}$$

Present value Benefit $$NuvärdeNytta = \sum_{t=0}^{T} B_t \times \frac{1}{(1+r)}$$

Net Present Value = present value of the stream of costs and benefits between year *t* and year *T*.

C_t = costs of year *t*

B_t = benefits in year *t*

r = discount rate

Social rate of discount in Sweden, 3,5 percent

Ramsey equation: $i = z + ng$

z = the pure rate of time preferences (d) + risk of disaster (L) = 1.5 (Heatco and HM Green Book GB, reference to empirical studies that indicate that the pure time preference rate (d) is around 0.5, and disaster risk (L) around 1).

n = the absolute value of the elasticity of the marginal utility of consumption = 1 (Heatco and HMTGB from empirical studies)

g = rate of growth of consumption per capita =1,78 (Swedish fore cast)

so i = the social rate of discount = 3.3 (we use 3.5)

Some of the different rates of discount in Europe

- **HEATCO** = Harmonised European Approaches for Transport Costing and Project Assessment. Reported estimates of the social interest rate of **3.0 percent.** Based on empirical evidence: z = 1,5; n = 1; g = 1,5 http://heatco.ier.uni-stuttgart.de/

- **European Comission** - The CBA methodology for analyzing the use of EU structural funds – recommends a discount rate of **5.0 percent**.
  http://ec.europa.eu/regional_policy/information/evaluations/guidance_en.cfm

- Germany 3.0
- Sweden from 4 to 3.5
- UK from 6.0 to 3.5
- Norway from 4.5 to 4.0

Debated handling of harmful long term effects – like Climate change.

- By using constant discount rate you assume that the productivity of investment is equal to the distant future as in the past, but the future is highly uncertain **- uncertainty about future discount rates give a general rationale for using a discount rate *decreasing over time.***

- In **Stern** ”review on the economics of climate change” – Stern used the Ramsey formula but assumed a low value of z= 0.1 per cent on the pure time preference when come to peoples ethical thoughts of fundamental changes instead of marginally different options and arrived at a social discount rate of **1.4 percent** when handling long term effects.
- **Sterns suggestion heavily debated**. For example **Wietzman and Nordhaus** with slightly different solutions, both concluded that instead the constant social discount rate should be **6 percent**.

ASEK 5 – NOW !

- The real (inflation-free) economic discount rate are at 3.5 percent.

Higher? - Systematic risk may be an argument for a higher rate of discount than the one determined by the Ramsey equation (3.3). Systematic risk correlated with changes in the economic cycle and therefore can not be diversified away.

*Lower? -There are scientific arguments for a social rate of discount decreasing over time (*A rough way to make an approximation for a declining rate of discount is to set the constant rate of discount at a low level).

Managing risk – The “breaker” of growth

How to deal with future uncertainty without penalizing objects with long life and good service development ?

- *The growth of traffic:* The growth of traffic, and thereby the estimated annual costs and benefits, is based on the forecast but is assumed to be zero remaining after the year of broken growth
- *The “breaker” of growth:* The 40th year of the evaluation period (if the period is longer than 40 years i.e. 60 year). **After this year the annual growth of traffic in CBA is assumed be zero and the volume of traffic remain constant the rest of the evaluation period**.

Life time of investments and evaluation periods

The project appraisal evaluation period: In ASEK 5.1 the evaluation period is defined as the economic lifetime of the investment, counted

Investment	***Economic lifetime***
• **New road**	**40-60 years**
• Pavement on an unpaved road	Max 15 years
• Particular actions for safety and good environment	Max 15 years
• New bicycle lane	Max 40 years
• **New railway**	**Max 60 years**
New rail	Max 30 years
• Gear	Max 20 years
• Facilities for contact wire	Max 40 years

Managing Risk -Successive calculation of infrastructure investments in Sweden

- Calculations of Costs are based on **a systematic assessment of the risks and uncertainties and their consequences**. The method takes successive into account the variations and uncertainties that naturally exists in the assessment of the cost of a project.

- Mean values and standard deviations are calculated using **statistical methods** and the results are presented in the form of **a weighted mean and an uncertainty range.**

- The **weighted Mean value** are represented in the **ordinary CBA**.

- For all projects with an economic investment cost at least 200 million SEK should **sensitivity analysis** be made: **Investment cost equivalent to 85% level in the uncertainty range is calculated.** Also sensitivity analyzes of Zero percent traffic growth.

New - old - debate in Sweden

Hultkrantz, L. , Krüger, N. and Mantalos, P. 2012,

Risk-adjusted long-term social rates of discount for transportation infrastructure investment

http://swoba.hhs.se/oruesi/abs/oruesi2012_014.htm

- They modify a method suggested by Martin Weitzman (2012) for determining a risk-adjusted social discount rate consistent with both the Ramsey rule and a consumption Capital Asset Pricing Model (CAPM).
- Based on estimates of the risk-free rate and the equity risk premium, they estimate the relevant rate to be 5-6 percent and only slowly declining within the investment horizon. This is as they point out higher than the current rates used in Sweden, Germany and the UK.

Model

the risk-adjusted rate of discount is a (beta-weighted) weighted average of the riskless and risky rates.

$$r_0^{\beta_0} = (1 - \beta_0) r^f + \beta_0 r^e$$

risk free asset r^f and risky equity r^e **2.0 and 6.5**

- Risk-free rates in Sweden = real-value Swedish government bonds. Current rates (September 2012) for bonds issued to 2028 are around 0,5 percent, while bonds with shorter remaining duration even are traded at negative rates. (Euro crisis). Chosing 2.0 procent as from “normal times”.
- Equity premiums (evaluated as the difference between stock return and return to long-term government bond) are set to 4.5 percent which give a total of 6.5. (sensitivity 5 percent)

Regression of *Beta*

- time series of traffic and GDP
- The analysis uses annual person-kilometer and ton-kilometer data for roads and railroads in Sweden for the period 1950–2011.
- The estimated “betas” range from 0.78 to 0.98, i.e., they are all close to one.

Conclusion?

The discount rate should be between 5 and 6 percent according to this study!

- Example: (1 – 0,78)*2.0 + 0.78*6.5 = **5,5**

Questions

- CAPM is a standard "workhorse" for Analyzing Financial Assets pricing, is that the correct method of calculating the systematic risk?
- Is it okey using historical data of BNP and traffic to estimate Beta?
- Disaster risk in Rasey formula and systematic risk in this model – same?
- How big are the individual risk when there is public funding?
- To be continued !

Link to trv.se of efficiency analysis and traffic forecasts in the transport sector:
http://www.trafikverket.se/samhallsekonomiochprognoser