

German Electricity Infrastructure Incentive Regulation: Simultaneously Overcapitalizing and Underexpending in Infrastructure?

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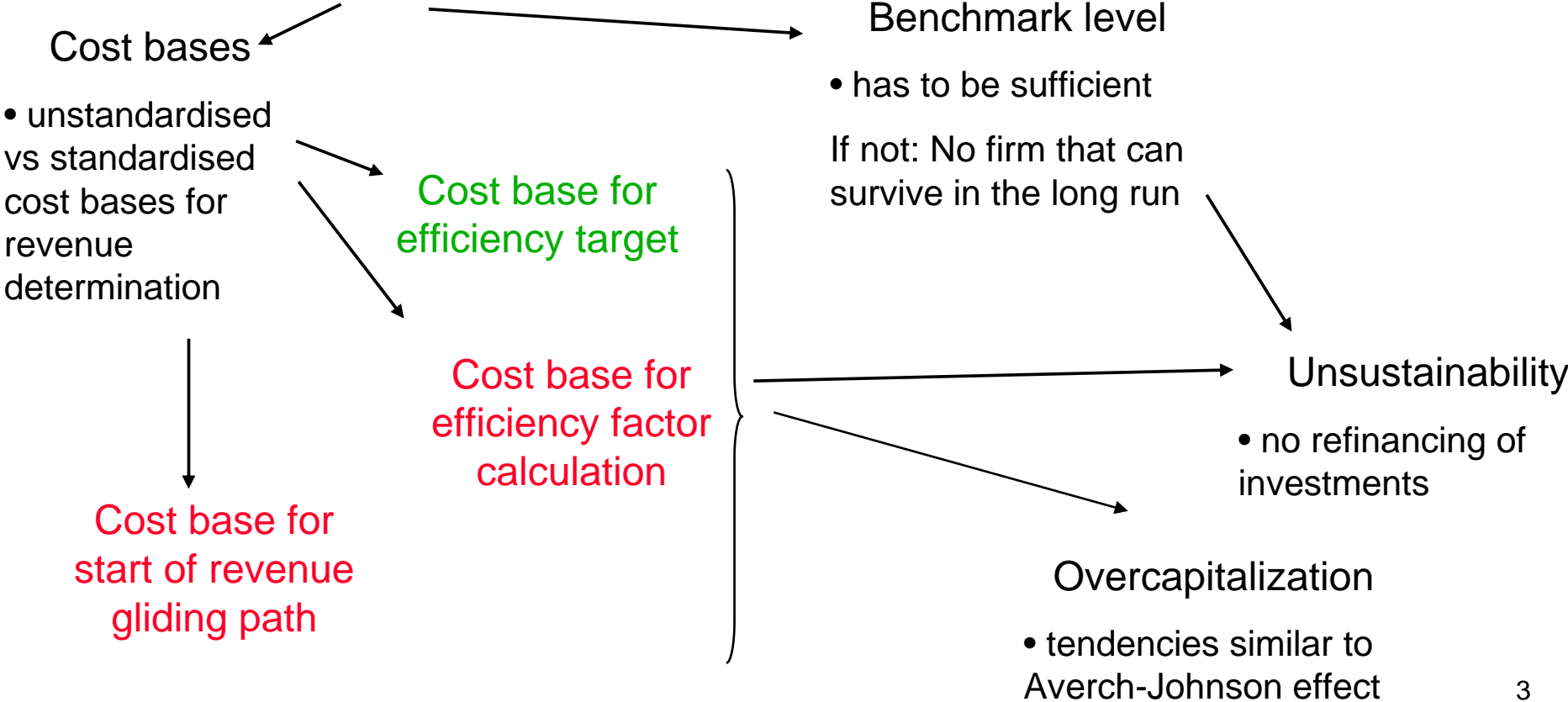
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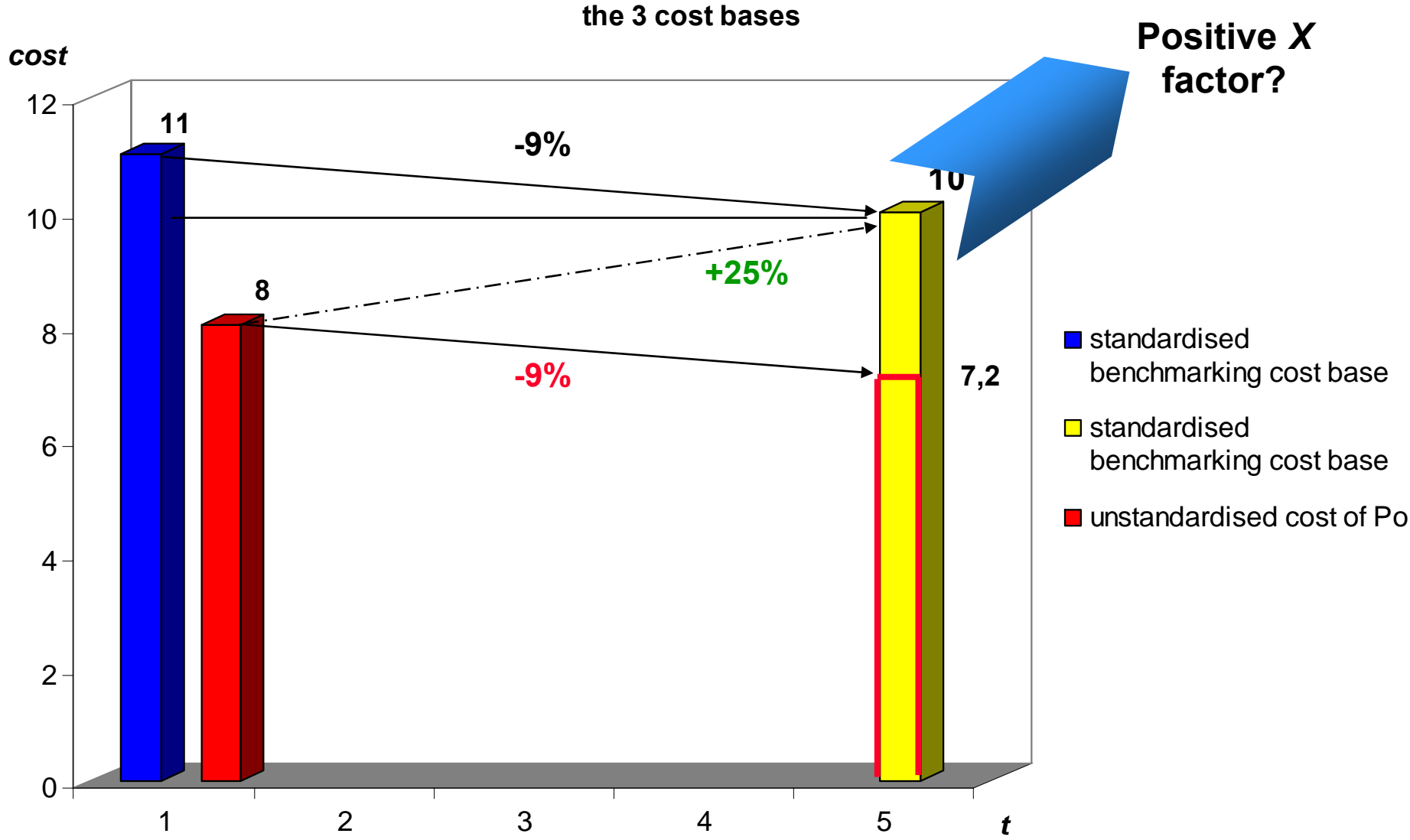
Overview

1. Introduction of the problem
2. Various problems in refinancing caused by insufficient standardisation
 1. Different depreciation policies
 2. Different activation policies
 3. Heterogeneous capital structures
 4. Application of two cost bases
 5. Efficient firm standard
3. Overcapitalization tendencies
 - Asset register with standardised cost
4. Possible solutions and their drawbacks
5. Annex: Proofs

„Incentive Regulation in Germany: Averch-Johnson and Unsustainable Refinancing of Infrastructure?“

- German by-law will introduce Revenue Cap-Yardstick Hybrid
- Key elements of regulation:





The 3 cost bases

- Firm i 's profit in *pure yardstick*:

$$\pi_i = R_i - C_{unstd,i}$$

$$\pi_i = C_{unstd,i} \left(1 - \frac{C_{std,i} - \min C_{std,j}}{C_{std,i}} \right) - C_{unstd,i}$$

X_{ind}

$$\rightarrow \pi_i = \left(\min C_{std,j} - C_{unstd,i} \right)$$

- Additional X factor: $X_{3 \text{ cost bases}} = \frac{C_{std,i} - C_{unstd,i}}{C_{unstd,i}}$

The 3 cost bases

- Firm i 's profit in transition period: *hybrid yardstick-revenue cap*
- One benchmarking period with glide path

$$\pi_{p,i} = R_{p,i} - C_{unstd,p,i}$$

Glide path parameter

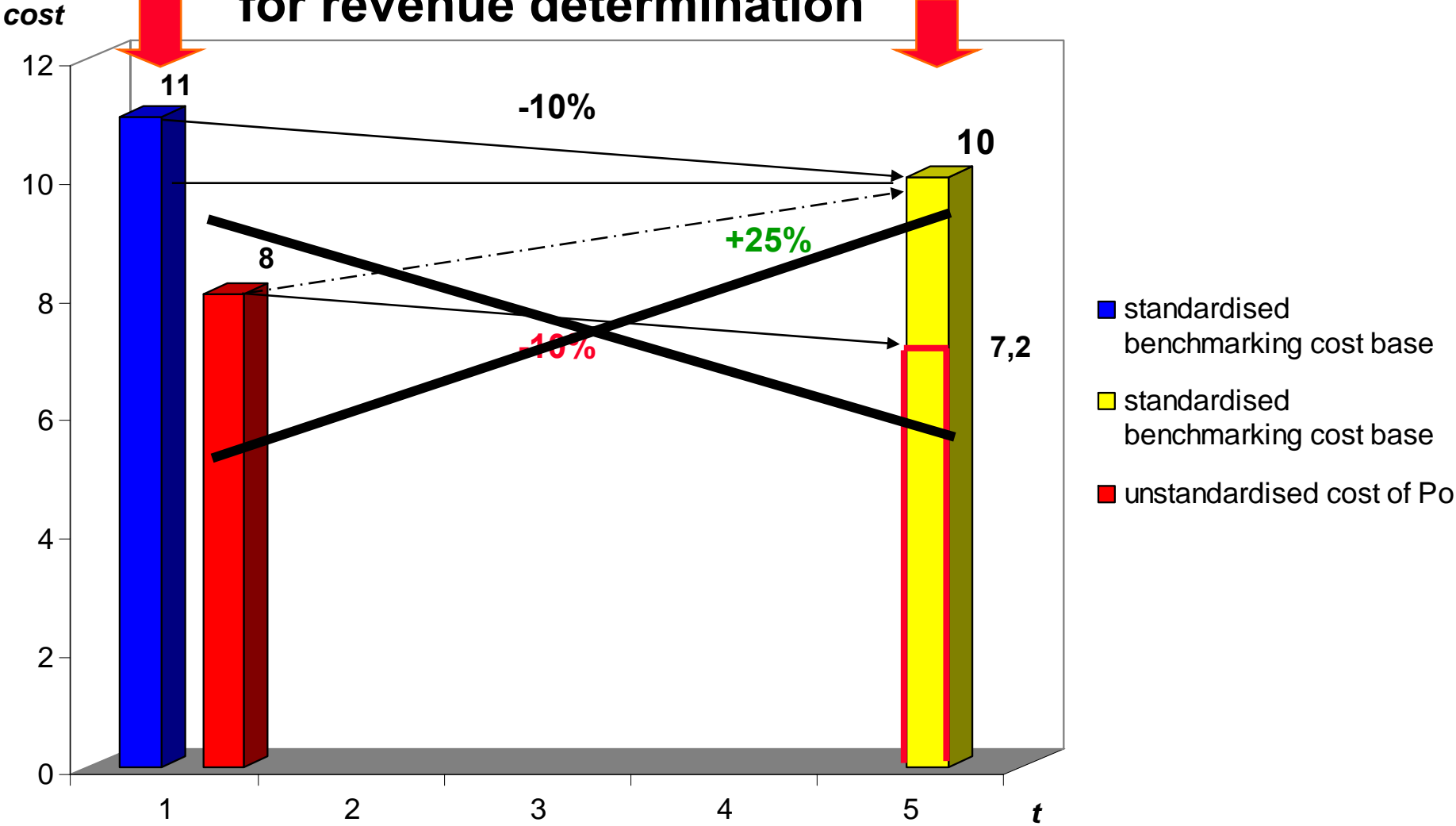
$$\pi_{p,i} = \sum_{t=1}^T C_{unstd,t,i} \left(1 - \alpha(t) \frac{C_{std,t,i} - \min C_{std,t,j}}{C_{std,t,i}} \right) - C_{unstd,t,i}$$

- Weighted revenue:

$$\pi_{p,i} = \sum_{t=1}^T \left(\text{Revenue cap} + \text{Benchmarking} \right) - C_{unstd,t,i}$$

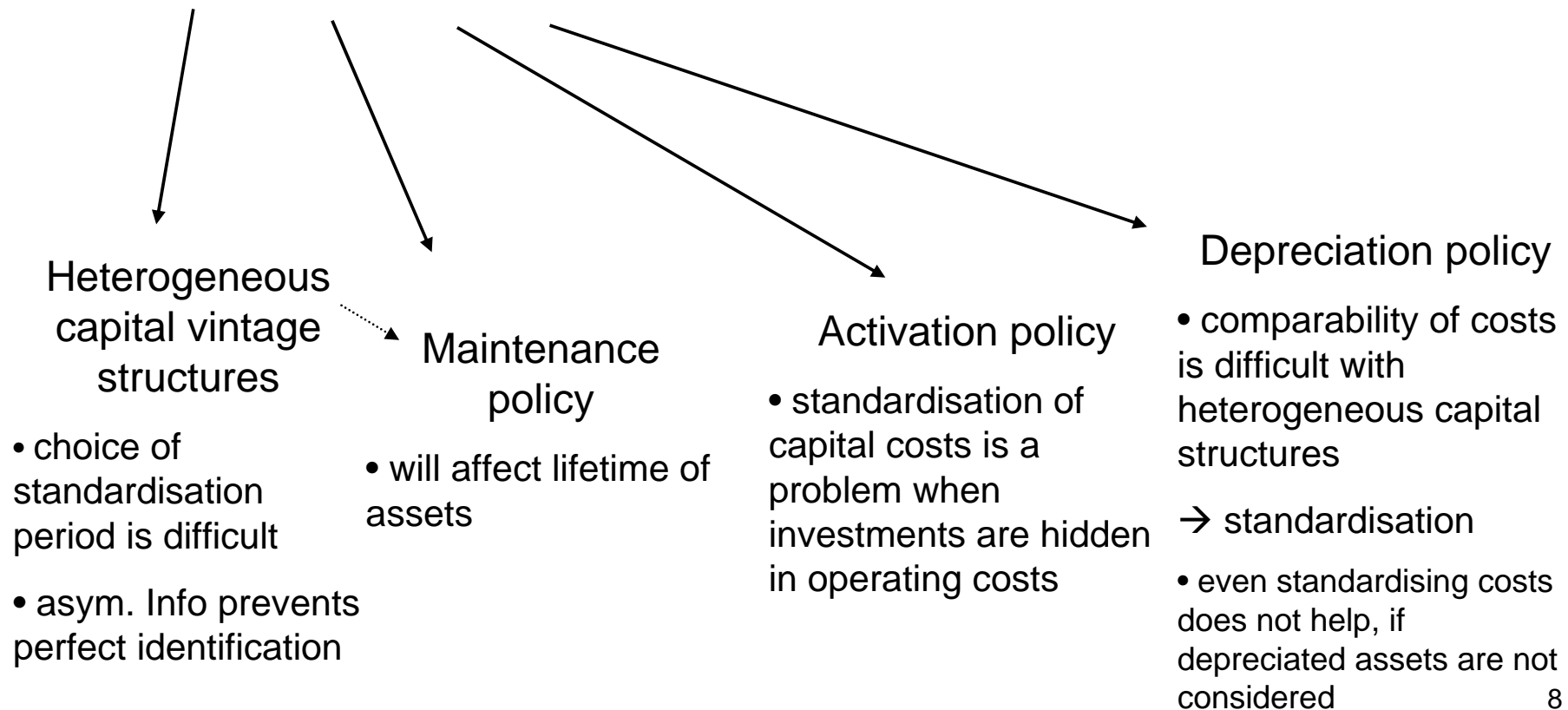
Revenue cap Benchmarking

just 2 standardised cost bases
the 3 cost bases
for revenue determination



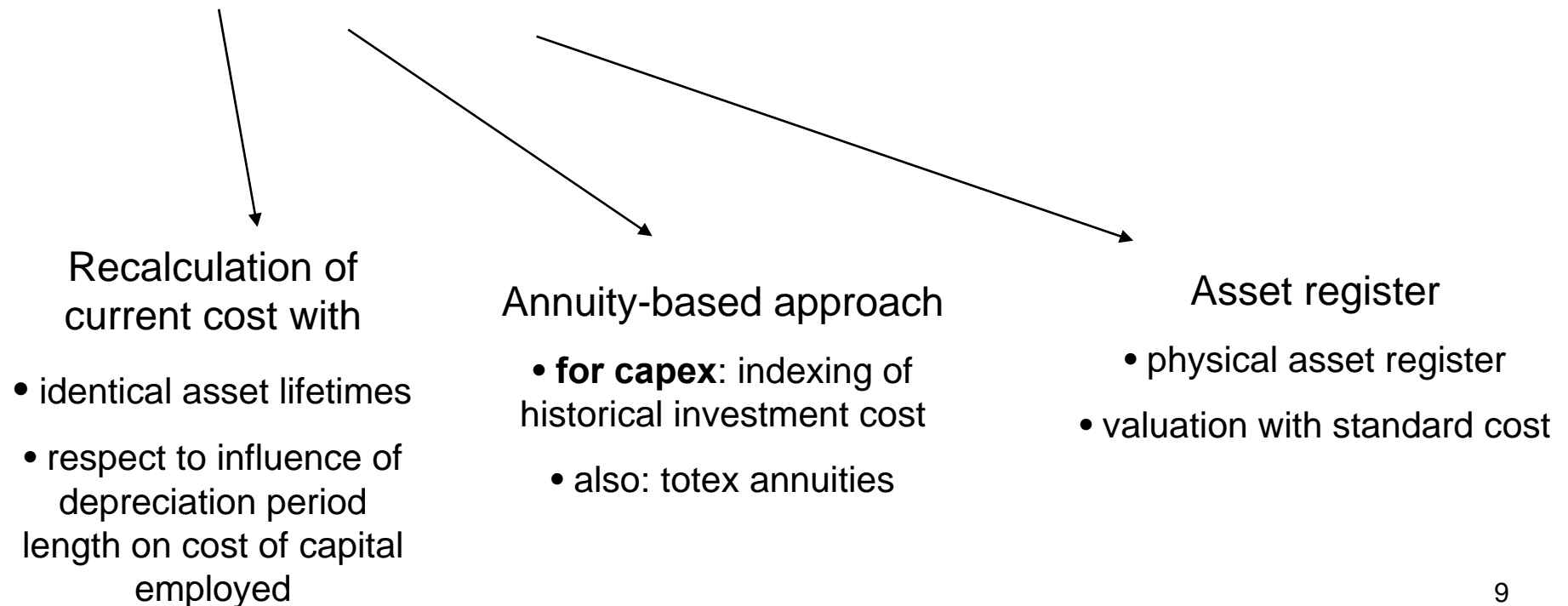
„Incentive Regulation in Germany: Averch-Johnson and Unsustainable Refinancing of Infrastructure?“

- German by-law will introduce Revenue Cap-Yardstick Hybrid
- Key challenges for regulation:



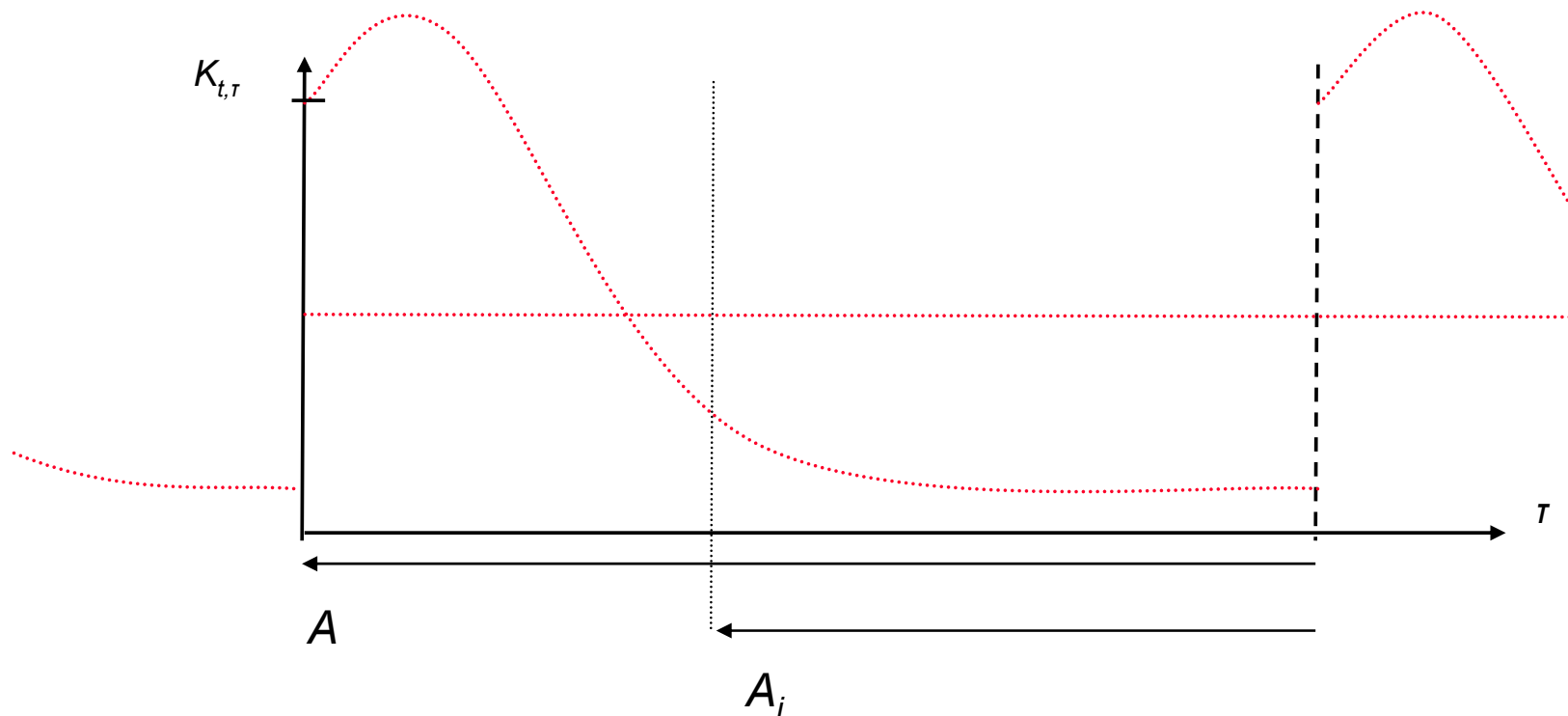
Key challenges for regulation – remedies?

- Attempts to control challenges:
- Different *standardisation approaches*



Depreciation policy

- Pure capex effect
- Investment cycles and „sudden death“ of assets

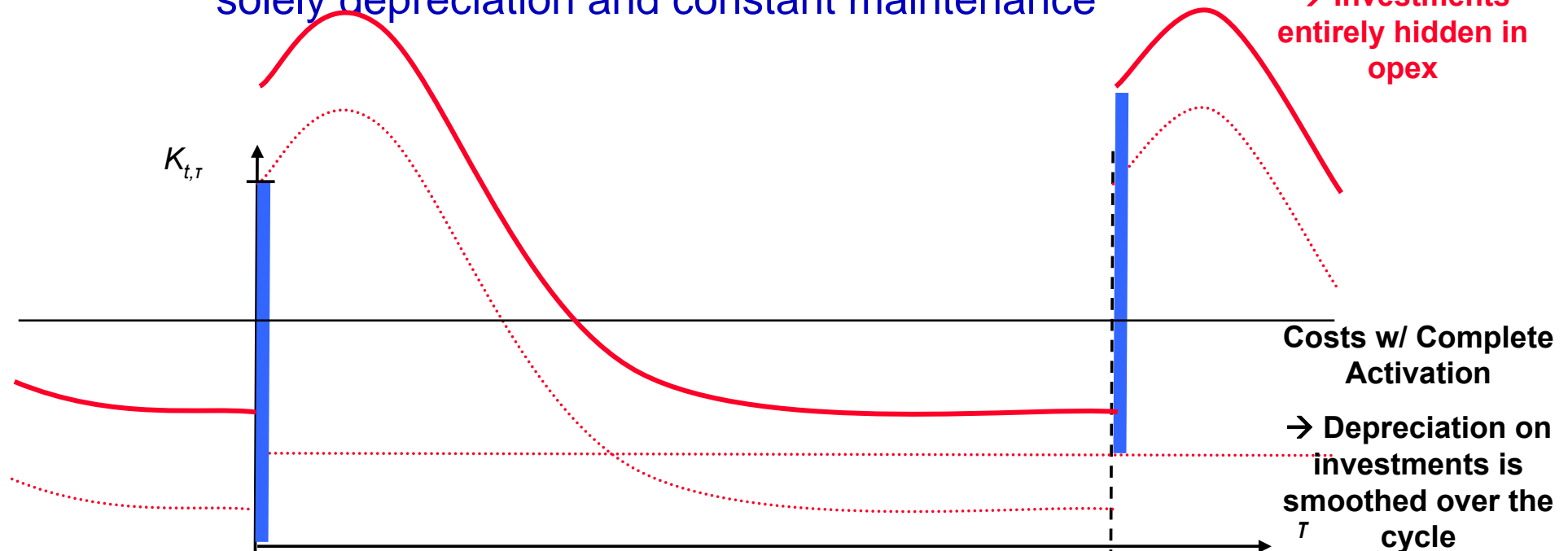


- Easy to deal with simple standardisation of depreciation periods
- Adapt cost of capital employed equivalently

Activation policy

- Constant lifetime \rightarrow constant length of investment cycle
- capital and operating costs:

solely depreciation and constant maintenance



\rightarrow Investment needs in t are entirely captured by costs in t and not distributed over depreciation period

Activation policy

$$K_{t,i} = \alpha_i a \sum_{\tau=1}^A K_{t,i,\tau} + (1-\alpha_i) a \sum_{\tau=1}^A K_{t,i,\tau}$$

capex *opex*

- Even if *capital* costs are standardised by an annuity-based approach, following cost base will result:

$$C_{t,i} = a \sum_{\tau=1}^A K_{t,i,\tau} - (1-\alpha_i) a \sum_{\tau=1}^A K_{t,i,\tau} + O_{t,i} + (1-\alpha_i) I_{t-N_{\max},i}$$

$$C_{t,i} = aK_G + O_{t,i} - (1-\alpha_i)(aK_G - I_{t-N_{\max},i})$$

- A regulator would derive following benchmark:
(for the sake of simplicity identical activation policies are assumed)

$$B_t = aK_G + O_{t,i} - (1-\alpha)aK_G + (1-\alpha) \min_{i \in S} I_{t-N_{\max},i}$$

→ Would be easy to heal with annuity-based approach on **total** expenditure

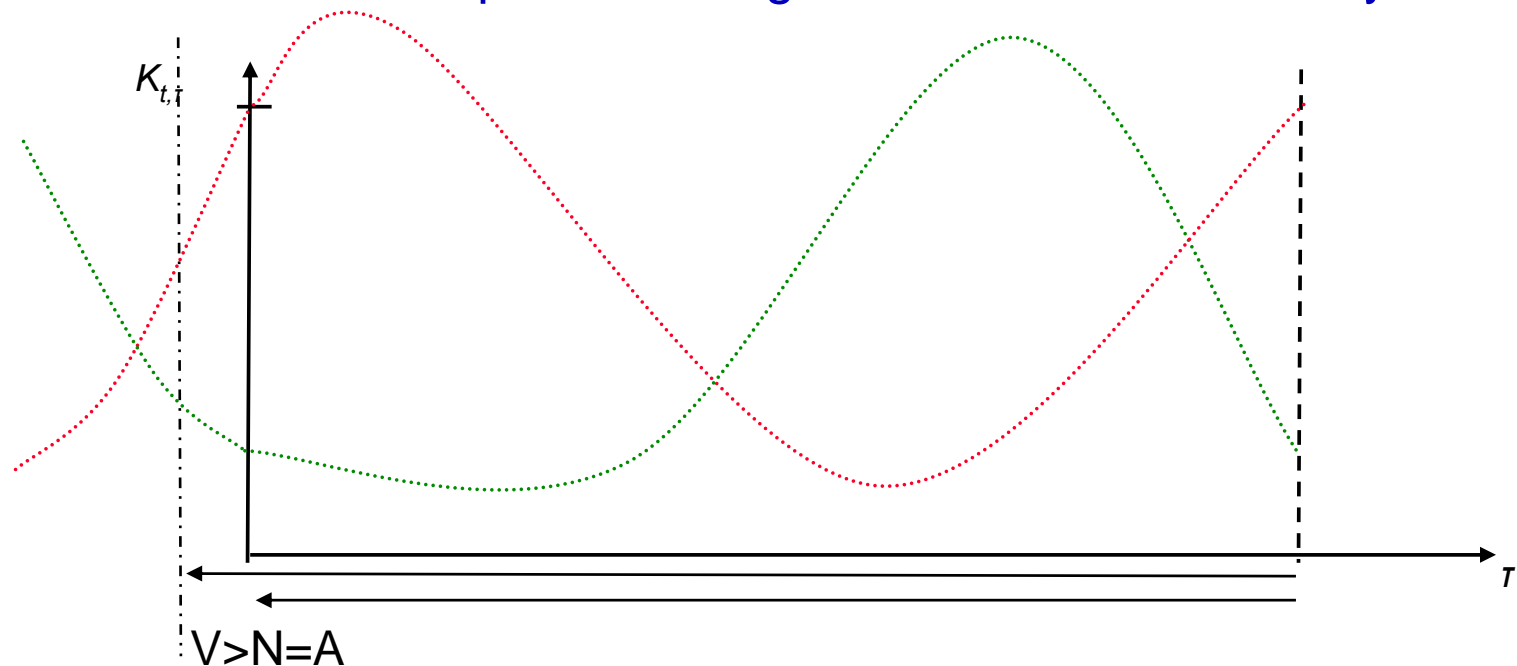
Heterogeneous capital structures

Even with an annuity-based approach on total cost, heterogeneous capital structures can lead to problems...

1. Standardisation period is not equal to the length of the investment cycles
2. Different maintenance strategies

Standardisation period \neq asset lifetime

- Example: Standardisation period is longer than the investment cycle



→ Benchmark would be set by:
$$B_t = aK_G + \min_{i \in S} aI_{t-N_{\max}-1,i}$$

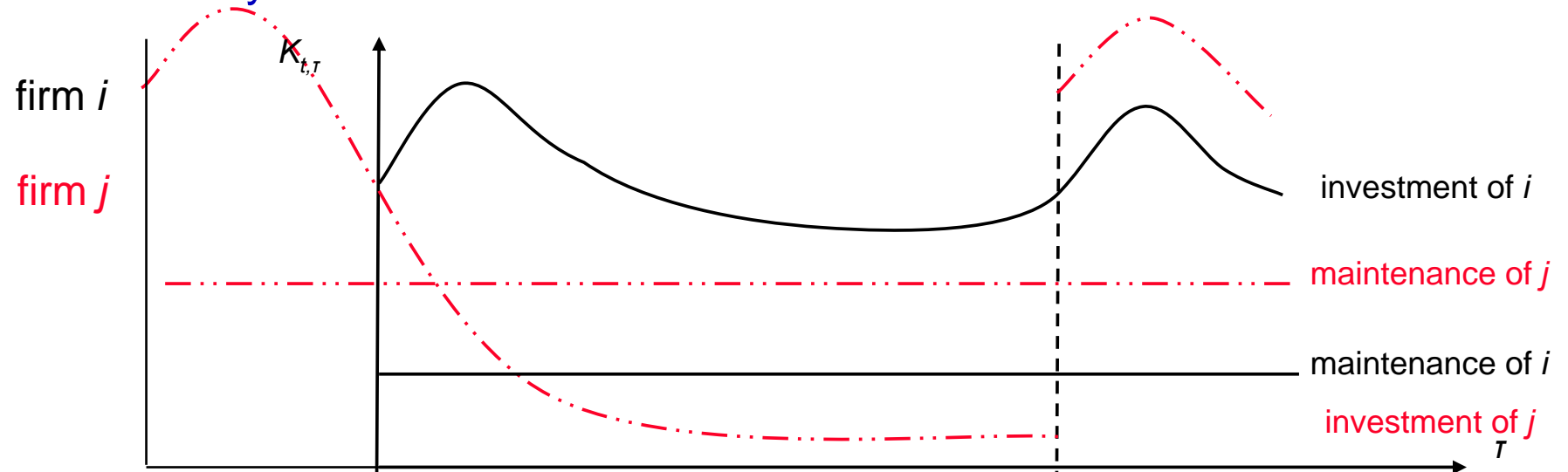
→ heterogeneous capital structures lead to unsustainable refinancing

Standardisation period \neq asset lifetime

- Consequence:
 - Standardisation period has to be set equal to asset lifetime
 - annuity-based approach based on indexed historical cost, of course doesn't help neither
 - Asset lifetimes would have to be respected individually
- Possible solution: Asset register with current cost
 - consideration of one entire capital stock

Different maintenance strategies

- If grid operators have influenced the asset lifetime by different maintenance strategies, the standardised cost bases have also different cycles



→ The benchmark would be set by

$$B_t = \min_{j \in S} \left(aK_G \frac{\sum_{\tau=1}^{A_j} K_{t-\tau+1,j}}{K_G} \frac{A}{A_j} + o_t \phi_{\tau,j}^- K_G \right)$$

Different maintenance strategies

- Sustainability would be pure luck: if different capital costs and different operating costs would outweigh each other
- Very unlikely: Capital costs will probably tend to decrease more than operating expenditure will increase
- The same as before: Asset register with current cost

Efficient Firm Standard

- Certain variation in cost of respective firms → usual for competition
- Each firm will have problems of refinancing in the long run
- Grid operators continue to produce as long as opex are covered
- Set the benchmark also for sustainably efficient firms (...until they leave the market...)

- proposition:

- instead of $\pi_i = \min C_{std,j} - C_{unstd,i}$

- better

$$\pi_i = \sum_{j=1}^M \gamma \frac{1}{M} C_{std,j} - C_{unstd,i}$$

„convenient“ intensity of competition

→ workable competition

Overcapitalization

- 3 cost bases can lead to overcapitalization
 - Application of **asset register** necessitates bottom-up construction of grid with **standard values**
 - Early replacement of assets will lead to a higher revenue level in P_0 , but the efficiency cost base remains constant if...
 - *Physical asset register remains constant and*
 - *Extra depreciation is allowed to increase revenue*
 - *Early = before ending of depreciation period and without replacement need*

Reason: Asset register with standard costs

- Take a look at two different NPVs

$$NPV_{real} = -(I + O) + \sum_{t=1}^A \frac{(1 - \alpha(t)\bar{X})C_t}{(1 + \kappa)^t}$$

$$NPV_{ann} = -(I + O) + \sum_{t=1}^A \frac{(1 - \alpha(t)\bar{X})C_t}{(1 + \kappa)^t}$$

$$\bar{X} = \frac{(r\bar{I} + a\bar{I} + o_0) - C_{BM}}{(r\bar{I} + a\bar{I} + o_0)}$$

Subtract the two to derive bonus of applying standard cost for benchmarking cost base: $NPV_{diff} = NPV_{ann} - NPV_{real}$

$$NPV_{diff} = \theta(I - \bar{I})$$

with $\theta > 0$

- For $I > \bar{I}$ grid operator receives discount on cost of capital employed
- MRTS changes which results in overcapitalization and higher costs

Results and Proposition

- First of all:

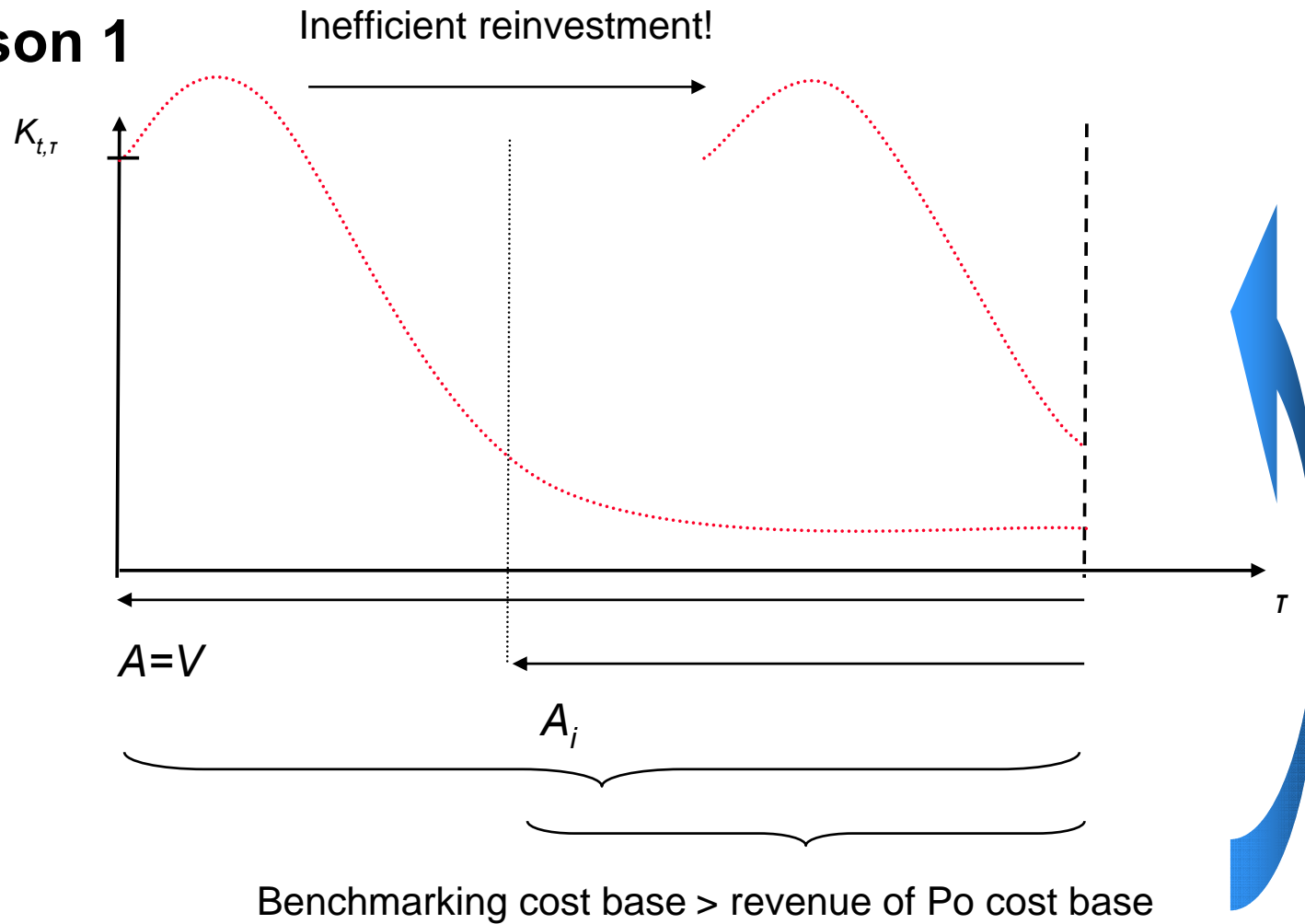
Use just two cost bases!

- Second:

Asset register with current cost evaluation of assets heals sustainable refinancing problems!

Thank you
for
your attention!

Reason 1



- Problem: 3rd cost base for revenue calculation in Po
→ just use two cost bases!