



The Value of expiring credits based on arbitrage theory

Klaus Wallner

Chair of Forest Economics
Technische Universität München

Kranichstein, 30.10.2009



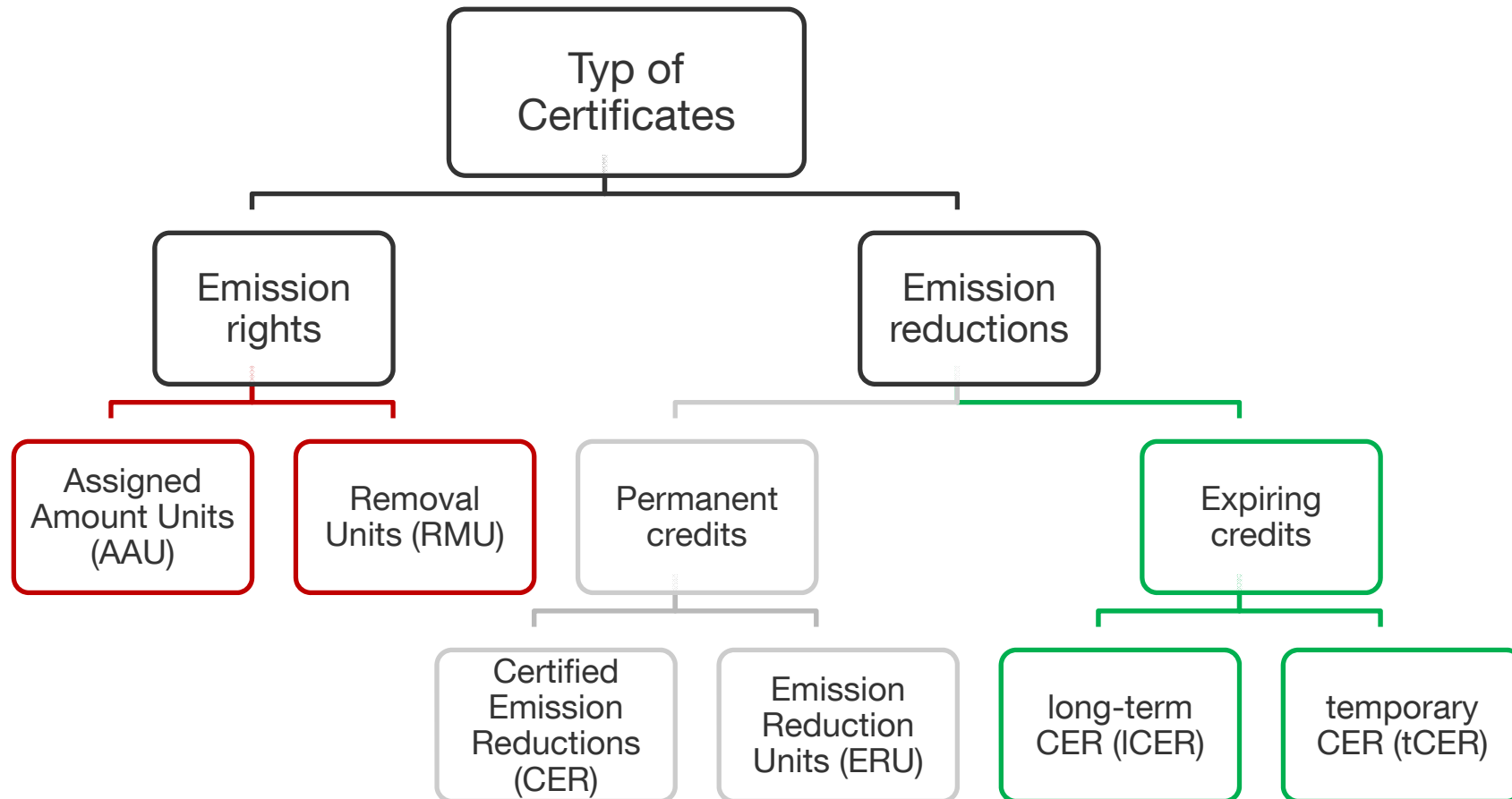
Agenda

- Types of Certificates & Kyoto Protocol
- Compliance
- Existing approach
- Cash flows of an expiring credit
- Arbitrage pricing by duplicating the cash flows

Agenda

- **Types of Certificates & Kyoto Protocol**
- Compliance
- Existing approach
- Cash flows of an expiring credit
- Arbitrage pricing by duplicating the cash flows

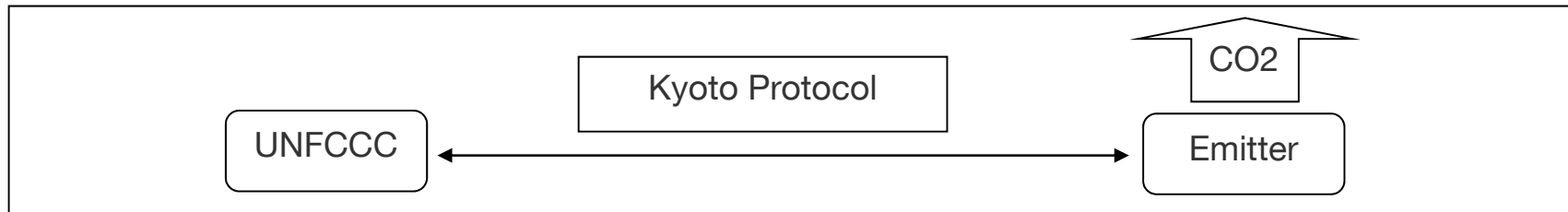
Types of Certificates & Kyoto Protocol



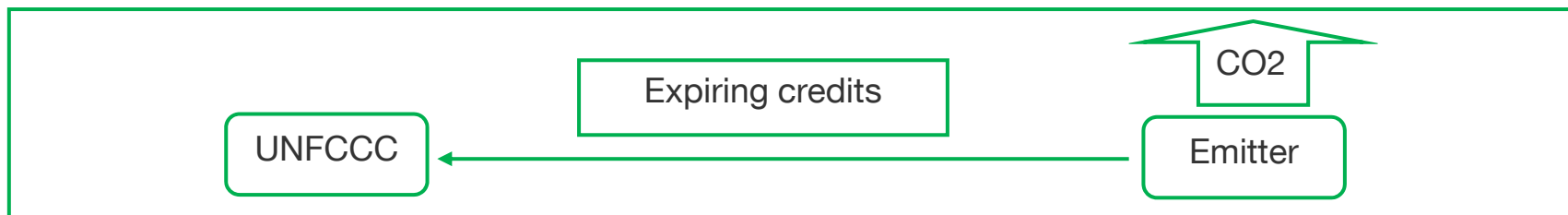
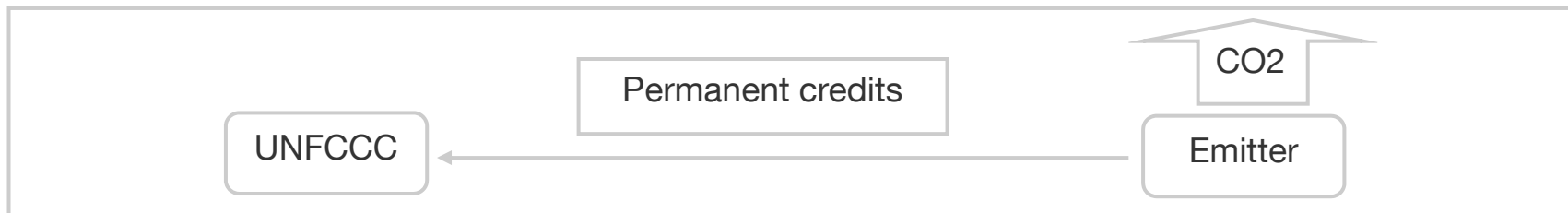
Agenda

- Types of Certificates & Kyoto Protocol
- **Compliance**
- Existing approach
- Cash flows of an expiring credit
- Arbitrage pricing by duplicating the cash flows

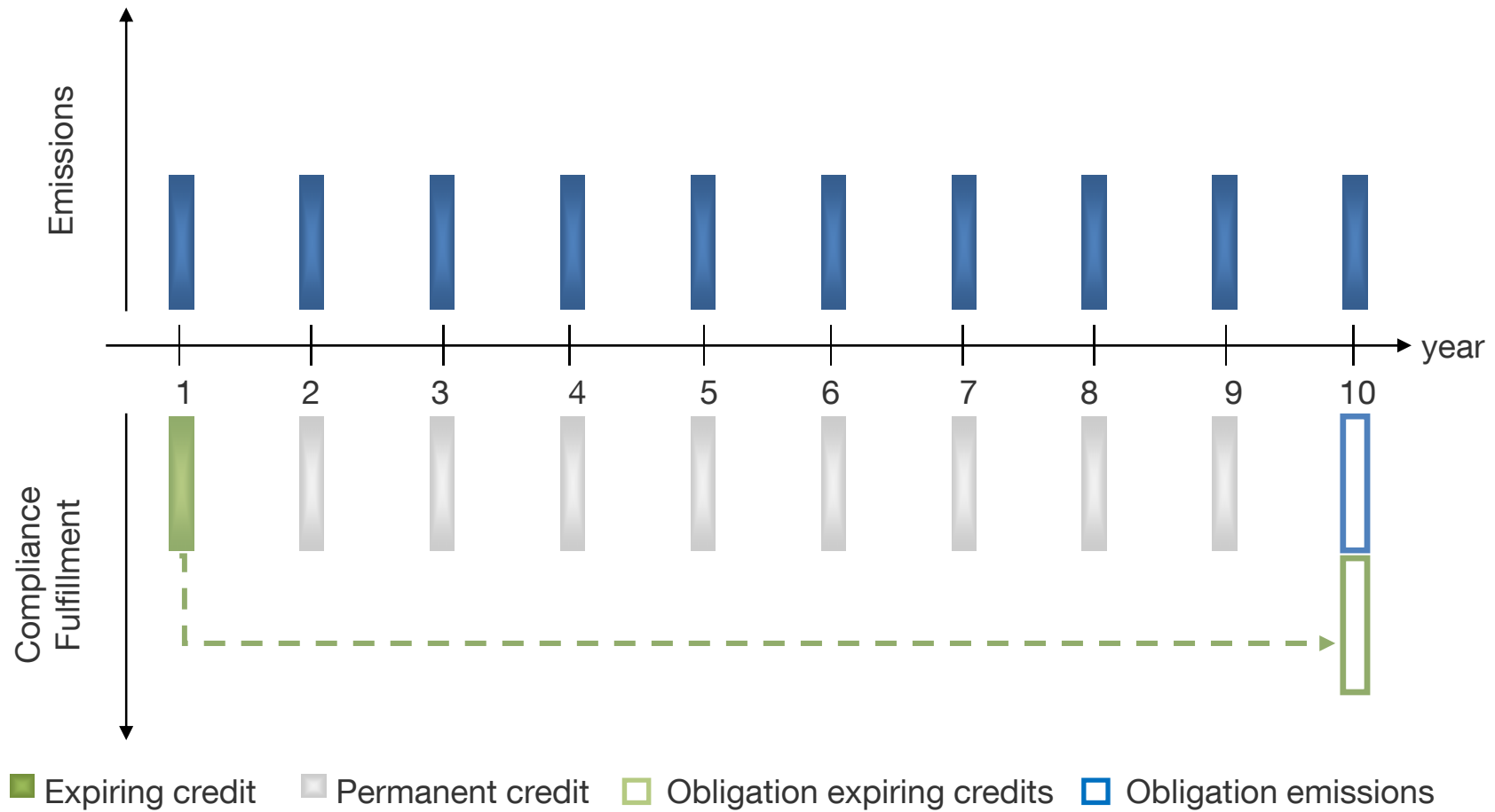
Compliance (1/2)



Two Options to fulfill the compliance obligation with emission reductions:



Compliance (2/2)





Agenda

- Types of Certificates & Kyoto Protocol
- Compliance
- **Existing approach**
- Cash flows of an expiring credit
- Arbitrage pricing by duplicating the cash flows

Existing approach – difference in time values (1/3)

$$\text{Price}_{\text{perm}} = \text{Price}_{\text{exp}} + \frac{\text{Price}_{\text{perm}}}{(1+i)^T}$$

$$\text{Price}_{\text{exp}} = \text{Price}_{\text{perm}} \times \left(1 - \frac{1}{(1+i)^T} \right)$$

$$\text{Price}_{\text{exp}} = \text{Price}_{\text{perm}} \times \left(1 - \frac{(1+v)^T}{(1+i)^T} \right)$$

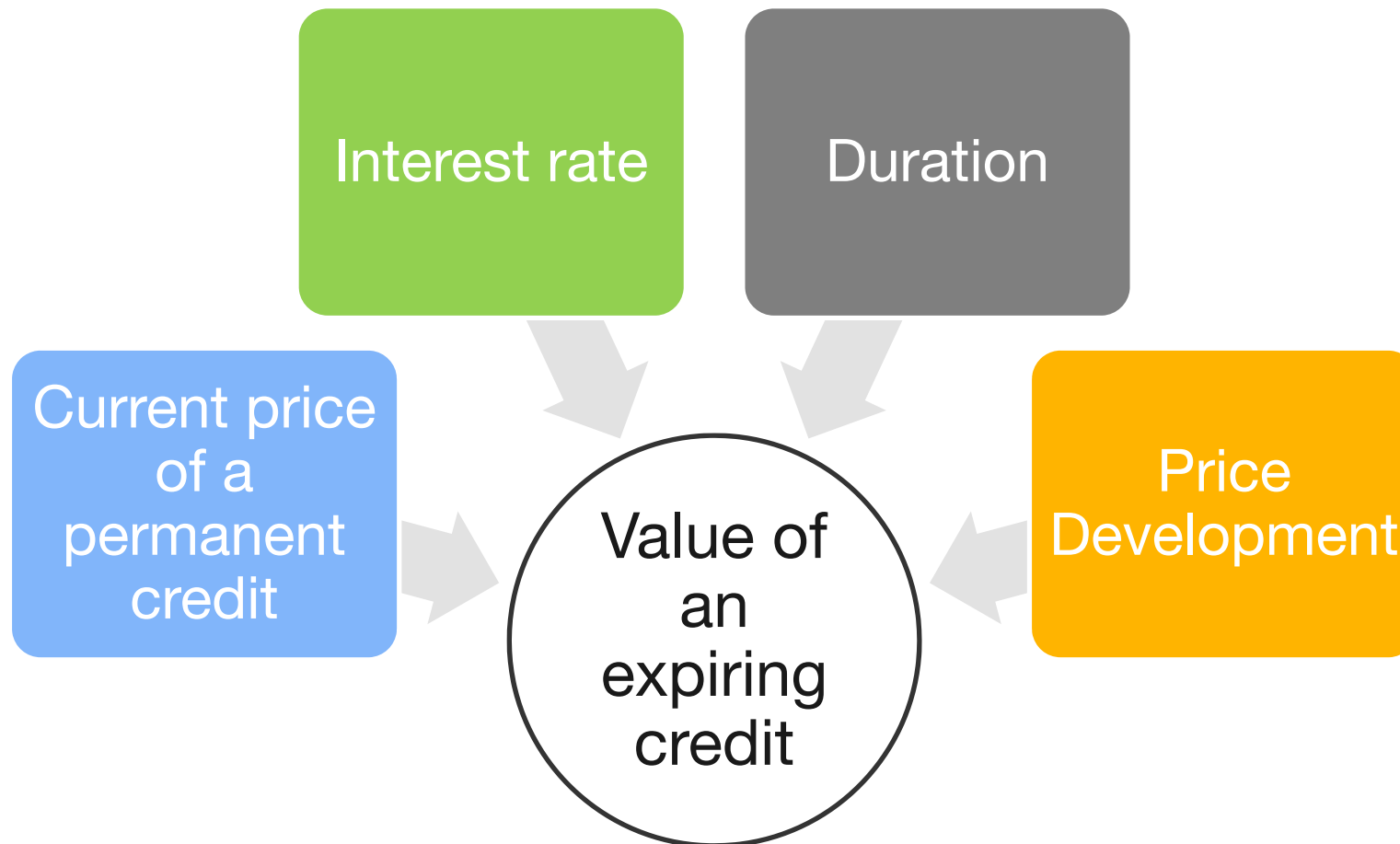
Existing approach – difference in time values (2/3)

$$\text{Price}_{\text{exp}} = \text{Price}_{\text{perm}} \times \left(1 - \frac{1}{(1+i)^T} \right)$$

$$\text{Price}_{\text{exp}} = \text{Price}_{\text{perm}} \times (1 - e^{(-i \cdot T)})$$

Permanent credit	15.00 €
Interest rate	0.025
Duration	6
Expiring credit	2.09 €

Existing approach – difference in time values (3/3)

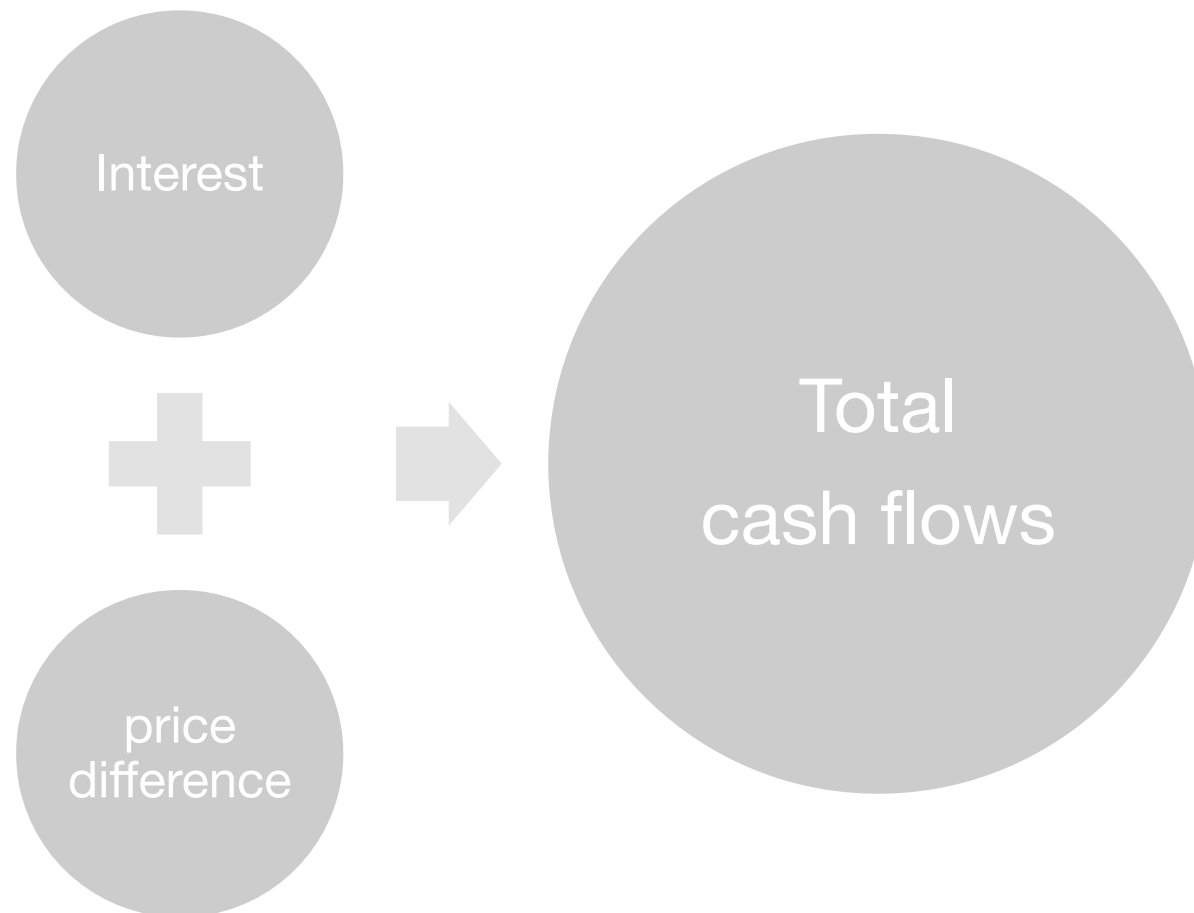




Agenda

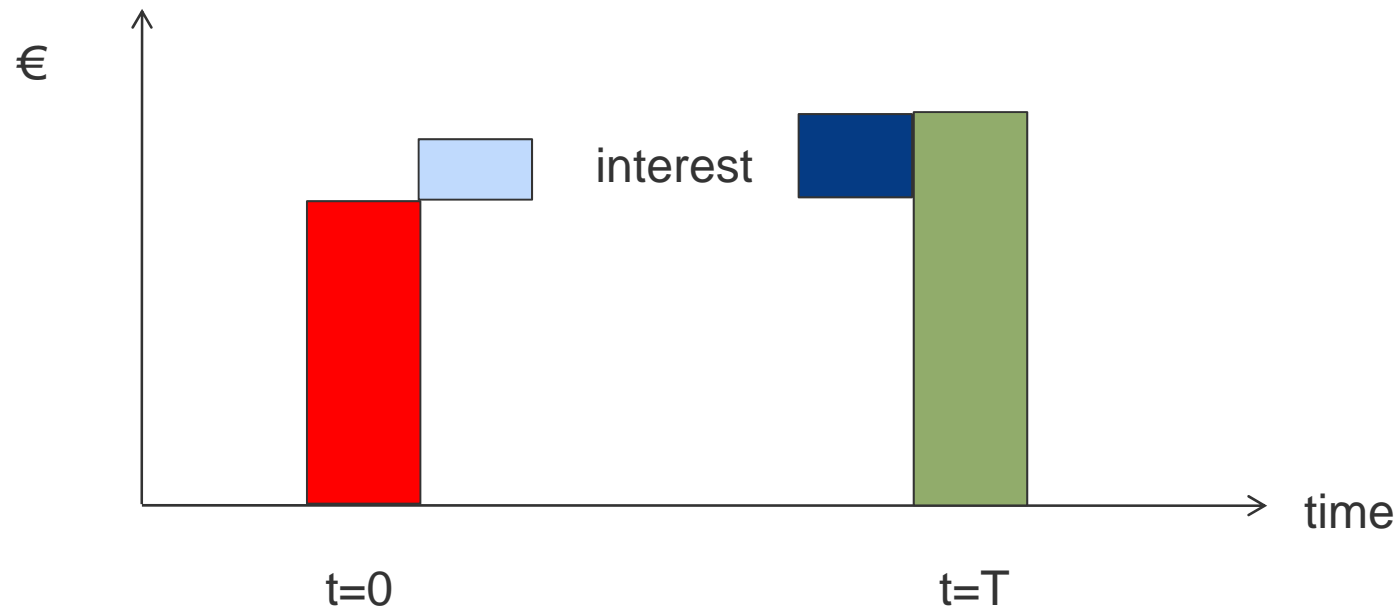
- Types of Certificates & Kyoto Protocol
- Compliance
- Existing approach
- **Cash flows of an expiring credit**
- Arbitrage pricing by duplicating the cash flows

Components of the total cash flow



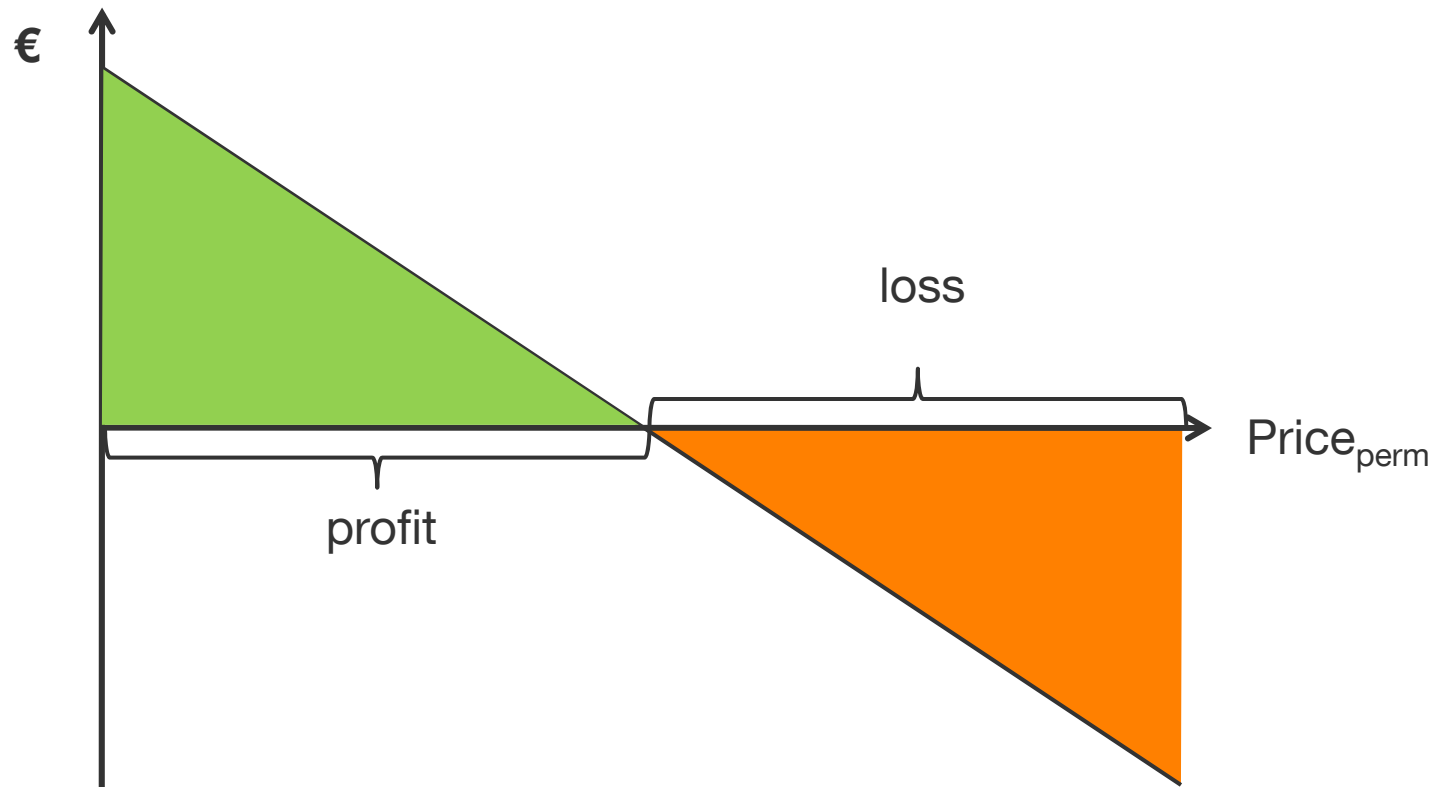
Flows of payment generated by an expiring credit (1/2)

- Postponement of an obligatory payment = financing effect

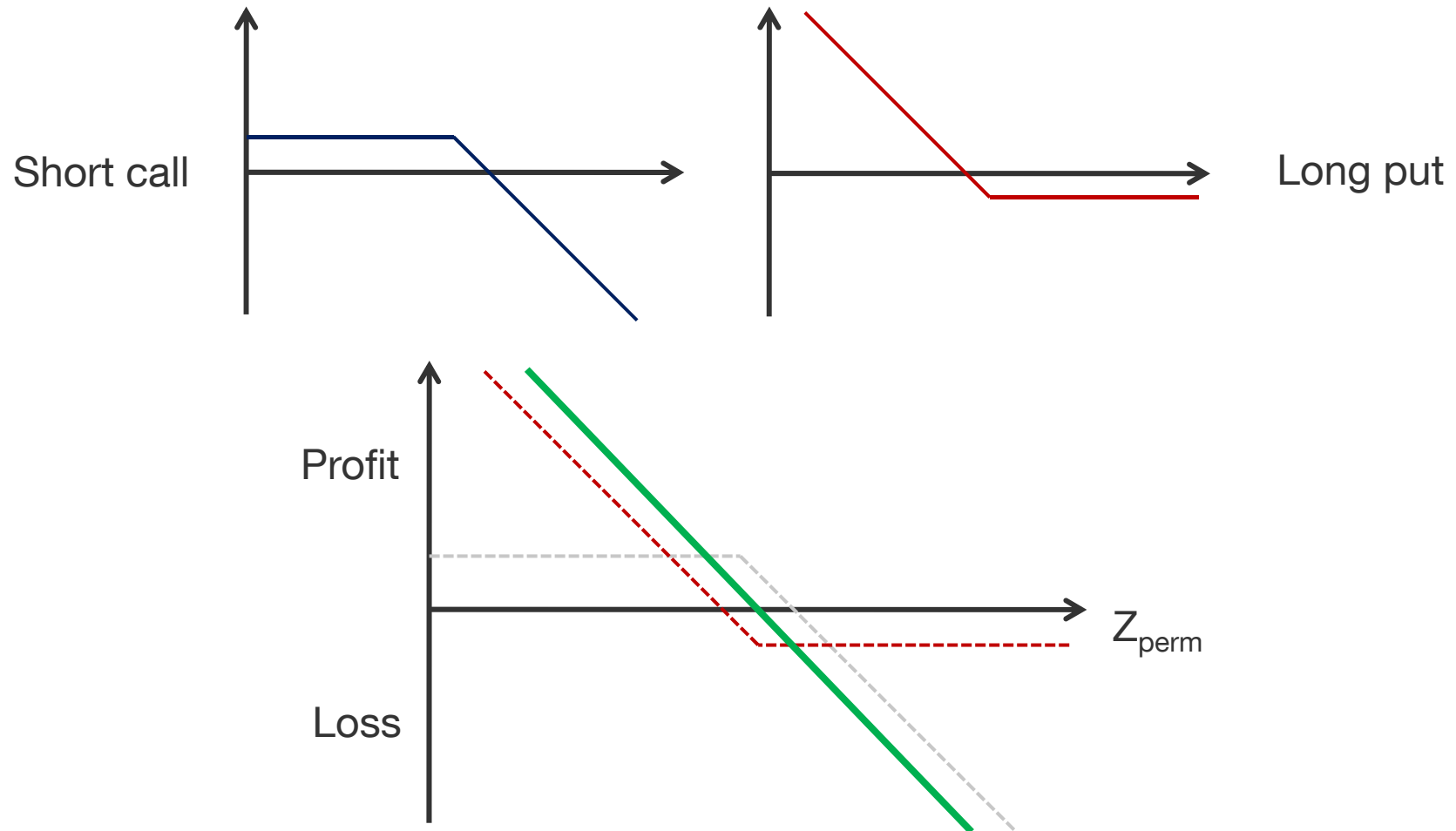


Flows of payment generated by an expiring credit (2/2)

- Possibility to make a profit or a loss based on a price difference ($t=0$, $t=T$)



The price risk





The portfolio

- For determining the financing effect Spot and Future-price of permanent credits could be used to derive some „marked-to-market“ financing costs.
- The difference between both is known as the cost of carry. It is assumed that no convenience yield, income or storage cost occur. Therefore the cost of carry is equal to the calculated interest (**Opportunity costs**).
- For the price risk it could be shown that a **combination of a short call and a long put** can duplicate the cash flow related to the price risk.



Agenda

- Types of Certificates & Kyoto Protocol
- Compliance
- Existing approach
- Cash flows of an expiring credit
- **Aribtrage pricing by duplicating the cash flows**

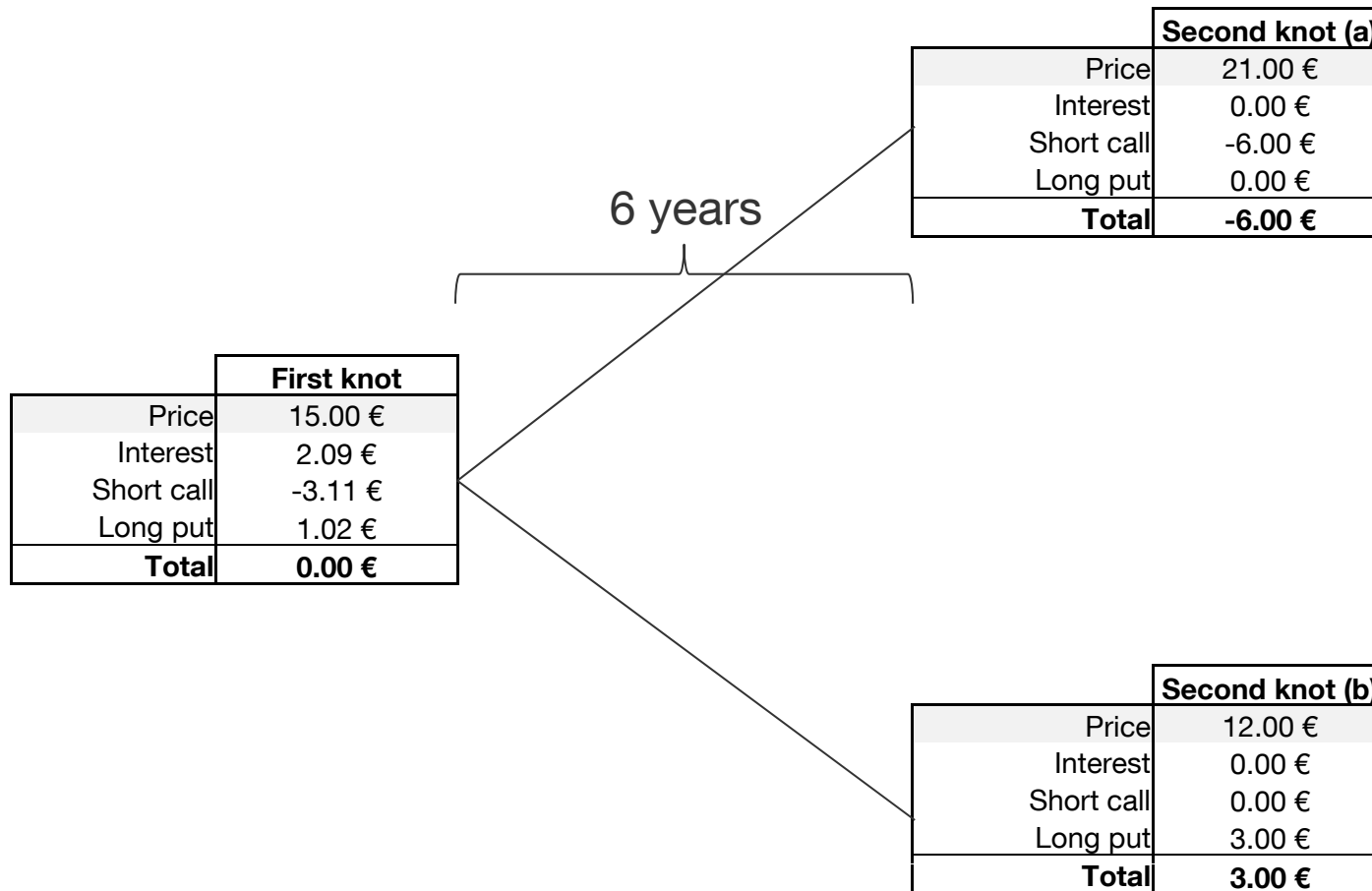


Case study

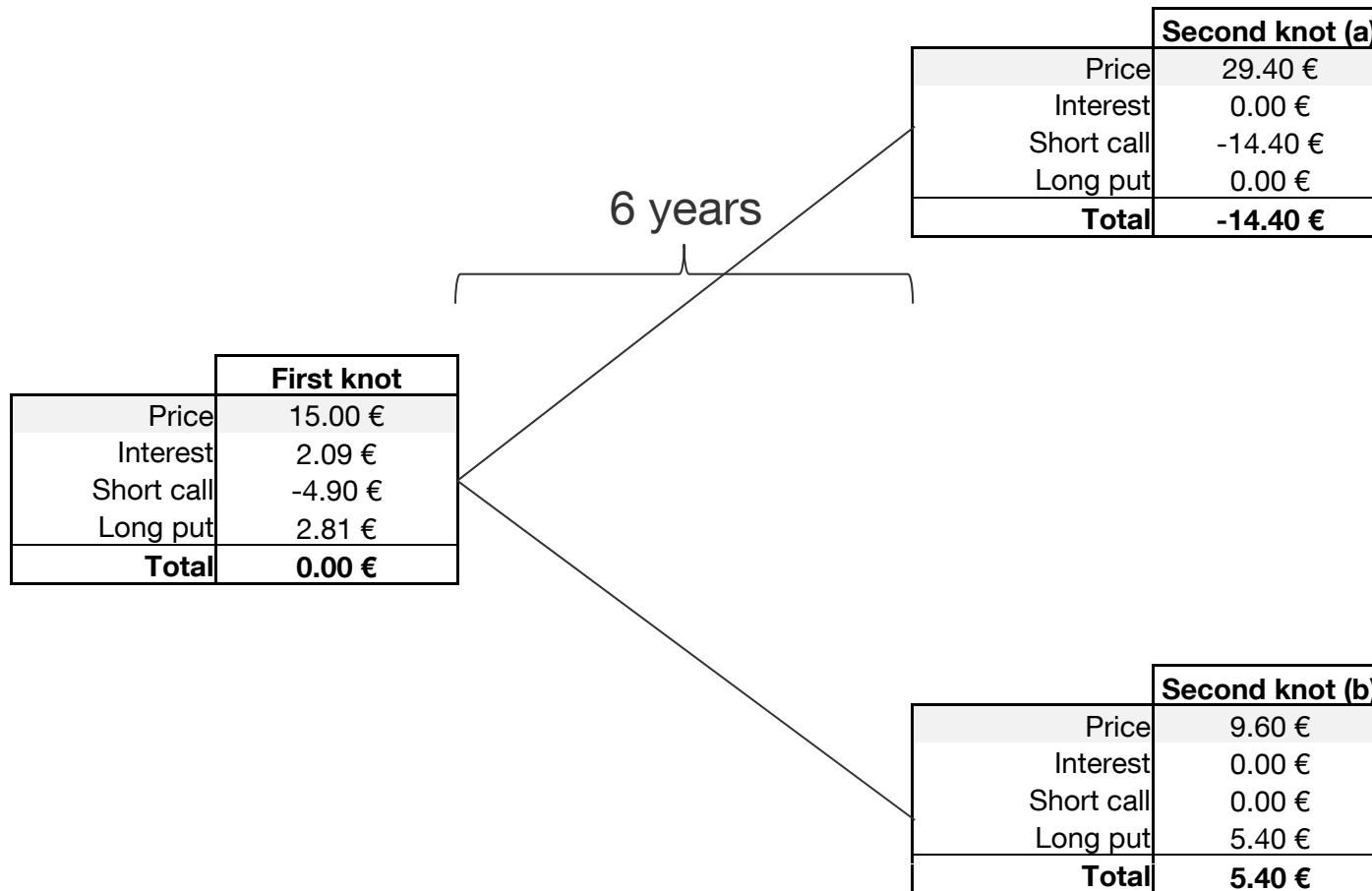
Description	Value
Price permanent credit	15.- € / 20.- €
Interest rate 1	0.025
Interest rate 2	0.06
Duration of an expiring credit in years	6
Up-move (Binomial modell)	1.4
Down-move (Binomial modell)	0.8



Binomial tree - one period (1/2)

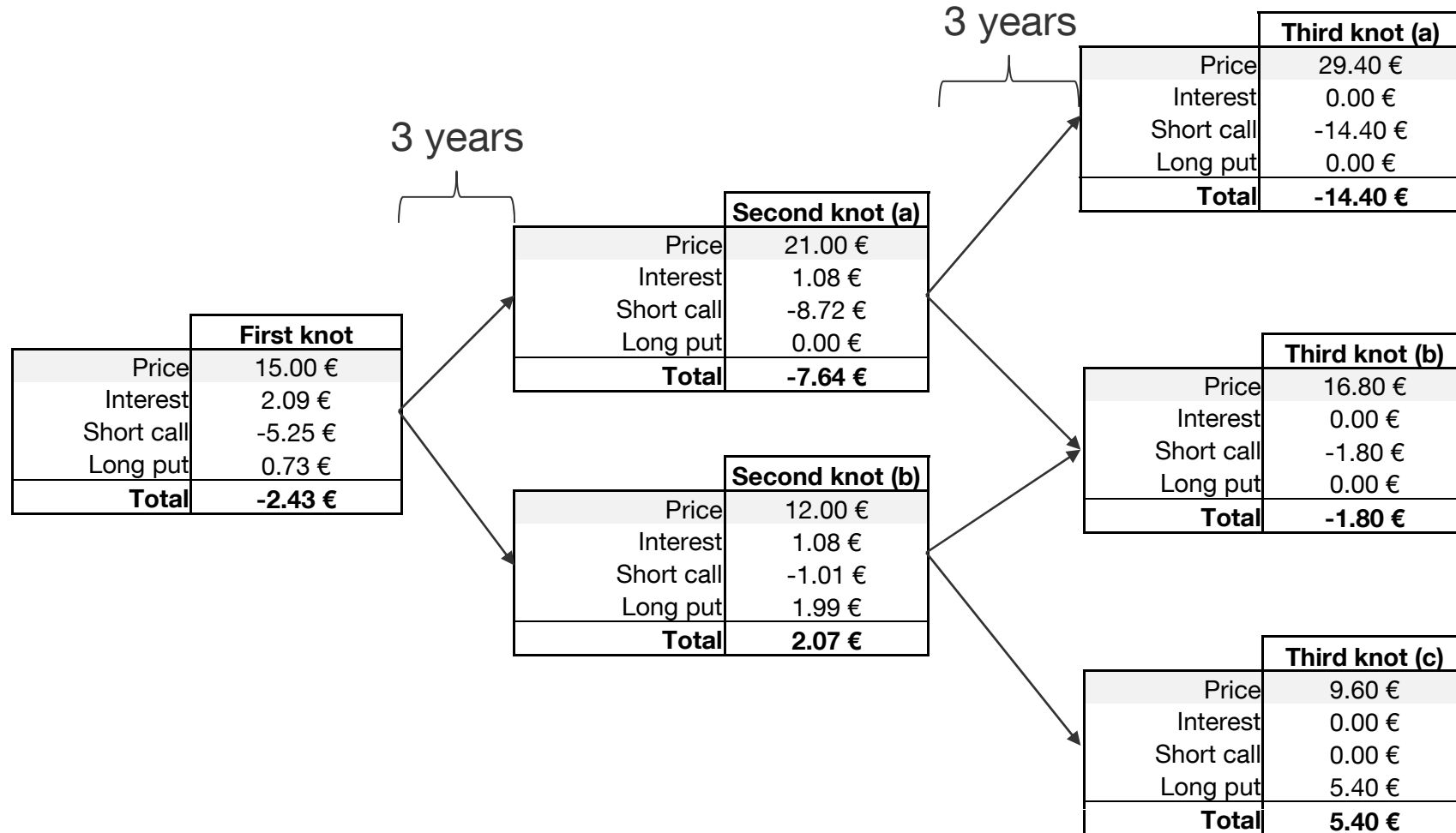


Binomial tree - one period (2/2)

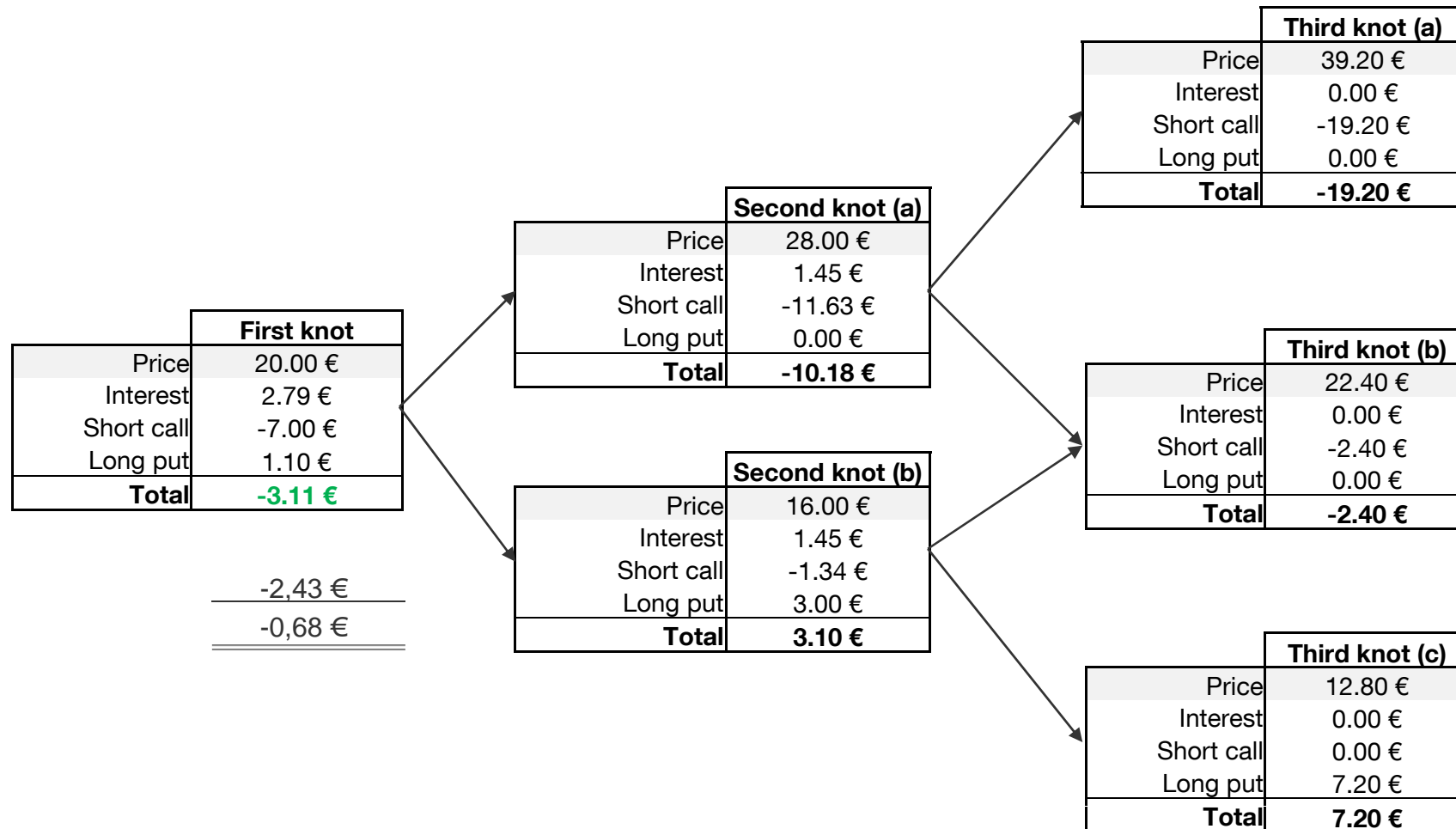




Binomial tree - two periods

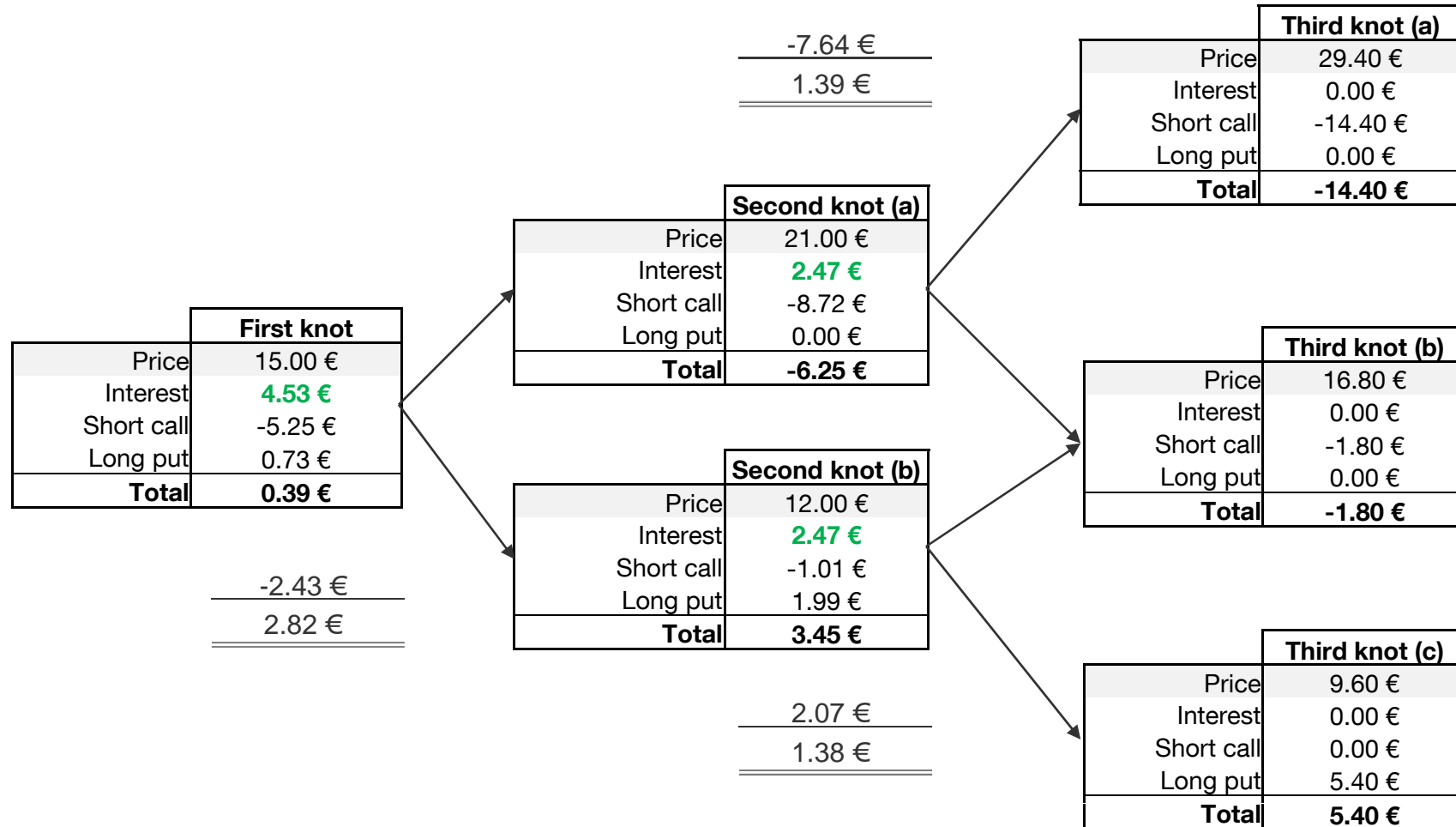


Different price of a permanent credit





Financing costs of the company



Conclusion

