

# What Information is Needed to Judge the Risk of Structured Financial Instruments?

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# 1 Introduction to the problem

- Motivation

- Increasing importance of Islamic Finance


(Source: GLOBAL ISLAMIC FINANCE & COMMERCE)

- Global market of Islamic financial products: 56 billion €
    - Expected growth over the next years to 350 billion €

- Structured financial products and the recent subprime crises
  - Citibank: 11 billion USD loss
  - Merrill Lynch: 8.4 billion USD loss
  - Industriegreditbank and SachsenLB had to be bailed out by their owners
- Banking supervision could not prevent this crisis.

- Questions

- First, measurement of the risk of structured financial instruments
- Second, information requirements of banking supervision



***Objective*** of presentation: to provide an answer to  
both questions

- Contribution of the presentation compared to the literature
  - New approach to measure risk: asset pricing theory as opposed to explicit risk measures
  - New insights on risk drivers: cash flow and context

## 2 Theory

### 2.1 Definitions

- Structured financial instrument
  - Consists of several basis products
  - One of these products is a derivative

- Derivative
  - Financial instrument
  - whose cash flow depends on the value of its underlying

- Risk
    - Future cash flows are not known today
    - Example
- 
- The diagram shows a binomial tree structure. At time  $t$ , there is a single node with the value 5. From this node, two arrows branch out to time  $t+1$ . The upper arrow is labeled with the probability  $1/4$  and points to a node with the value 10, which is labeled "State 1". The lower arrow is labeled with the probability  $3/4$  and points to a node with the value 0, which is labeled "State 2".



## 2.2 Methodology

- Asset pricing theory

Translates future risky cash flow into prices

- Test criterion

- Price of asset 1 in context 1 < price of asset 1 in context 2
- Context 1 *must* involve *more risk*
- Since lower price is associated with higher risk

- Description of the context of an investor
  - Definition
    - Context describes the environment in which the investment is embedded
    - Cash flow of the investment does not belong to its context

## – Example

## • Financial market

	price	cash flow in state 1 (probability: $\frac{1}{4}$ )	cash flow in state 2 (probability: $\frac{3}{4}$ )
Asset 1	5	10	0
Asset 2	90	100	100

## • Portfolio of “old” loans of a bank

Loans	?	120	80
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Context

- Structured financial instrument

Structured financial instrument	?	0	20
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} Invest-  
ment

## 2.3 Measuring Risk

- Two scenarios
  - Structured financial products *can be duplicated*
  - Structured financial products *cannot be duplicated*

## 2.3.1 Duplication possible

- What does duplication mean?

	price	cash flow in state 1 (probability: $\frac{1}{4}$ )	cash flow in state 2 (probability: $\frac{3}{4}$ )
Asset 1	5	10	0
Asset 2	90	100	100

Structured financial instrument	?	0	20
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	price	cash flow in state 1 (probability: $\frac{1}{4}$ )	cash flow in state 2 (probability: $\frac{3}{4}$ )
Asset 1	5	10	0
Asset 2	90	100	100
Structured financial instrument	?	0	20

$$-2 \cdot 10 + 0.2 \cdot 100 = 0$$

$$-2 \cdot 0 + 0.2 \cdot 100 = 20$$

- Duplication means

The financial market offers the *same cash flow* as the structured financial instrument.



- Duplication means

The financial market offers the ***same cash flow*** as the structured financial instrument.

- Duplication portfolio (= financial market) and structured financial instrument are identical from an economic point of view.

***Duplication possible***

	price	cash flow in state 1 (probability: $\frac{1}{4}$ )	cash flow in state 2 (probability: $\frac{3}{4}$ )
Asset 1	5	10	0
Asset 2	90	100	100
Structured financial instrument	?	0	20

$$-2 \cdot 10 + 0.2 \cdot 100 = 0$$

$$-2 \cdot 0 + 0.2 \cdot 100 = 20$$

- Consequences

- 1<sup>st</sup> consequence

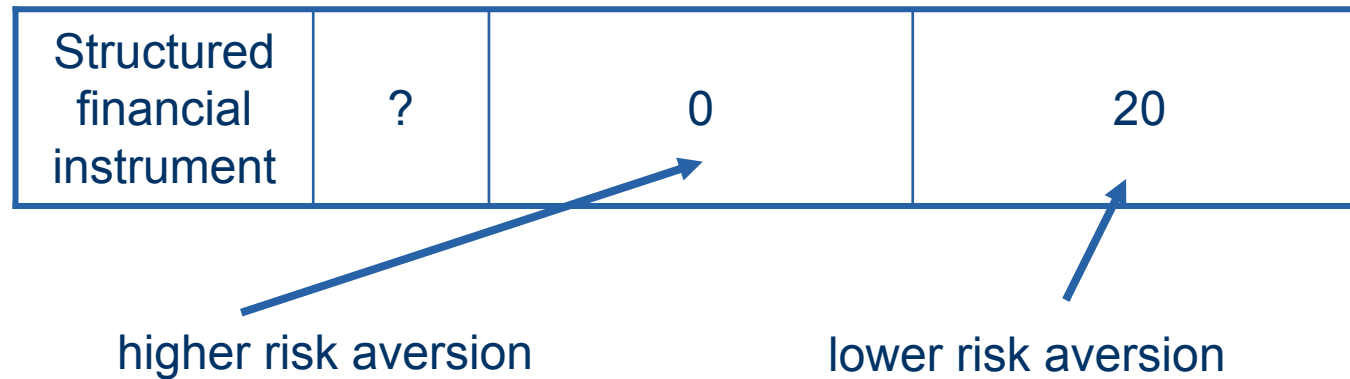
- Price of structured financial product = price of duplication portfolio (Black/Scholes methodology):

$$-2 \cdot 5 + 0.2 \cdot 90 = 8$$

- Identical price  $\Rightarrow$  structured financial instrument has the same risk as the duplication portfolio

– 2<sup>nd</sup> consequence

- Risk preferences do **not** matter



- State probabilities (1/4 or 3/4) do **not** matter

– 3<sup>rd</sup> consequence

The portfolio of “old” loans of the bank does ***not*** matter.



## 2.3.2 Duplication impossible

- What does impossible duplication mean?

*modified* financial market

	price	cash flow in state 1 (probability: $\frac{1}{4}$ )	cash flow in state 2 (probability: $\frac{3}{4}$ )
Asset 2	90	100	100

Structured financial instrument	?	0	20
---------------------------------------	---	---	----

	price	cash flow in state 1 (probability: $\frac{1}{4}$ )	cash flow in state 2 (probability: $\frac{3}{4}$ )
Asset 2	90	100	100
Structured financial instrument	?	0	20

$$0.2 \cdot 100 = 20 > 0$$

$$0.2 \cdot 100 = 20$$

	price	cash flow in state 1 (probability: $\frac{1}{4}$ )	cash flow in state 2 (probability: $\frac{3}{4}$ )
Asset 2	90	100	100
Structured financial instrument	?	0	20

$$0.1 \cdot 100 = 10 > 0$$

$$0.1 \cdot 100 = 10 < 20$$



- Duplication impossible means

The financial market offers a *different cash flow* than the structured financial instrument.

- Financial market and the structured financial instrument are *no longer* identical from an economic point of view.

*Duplication impossible*

- Consequences

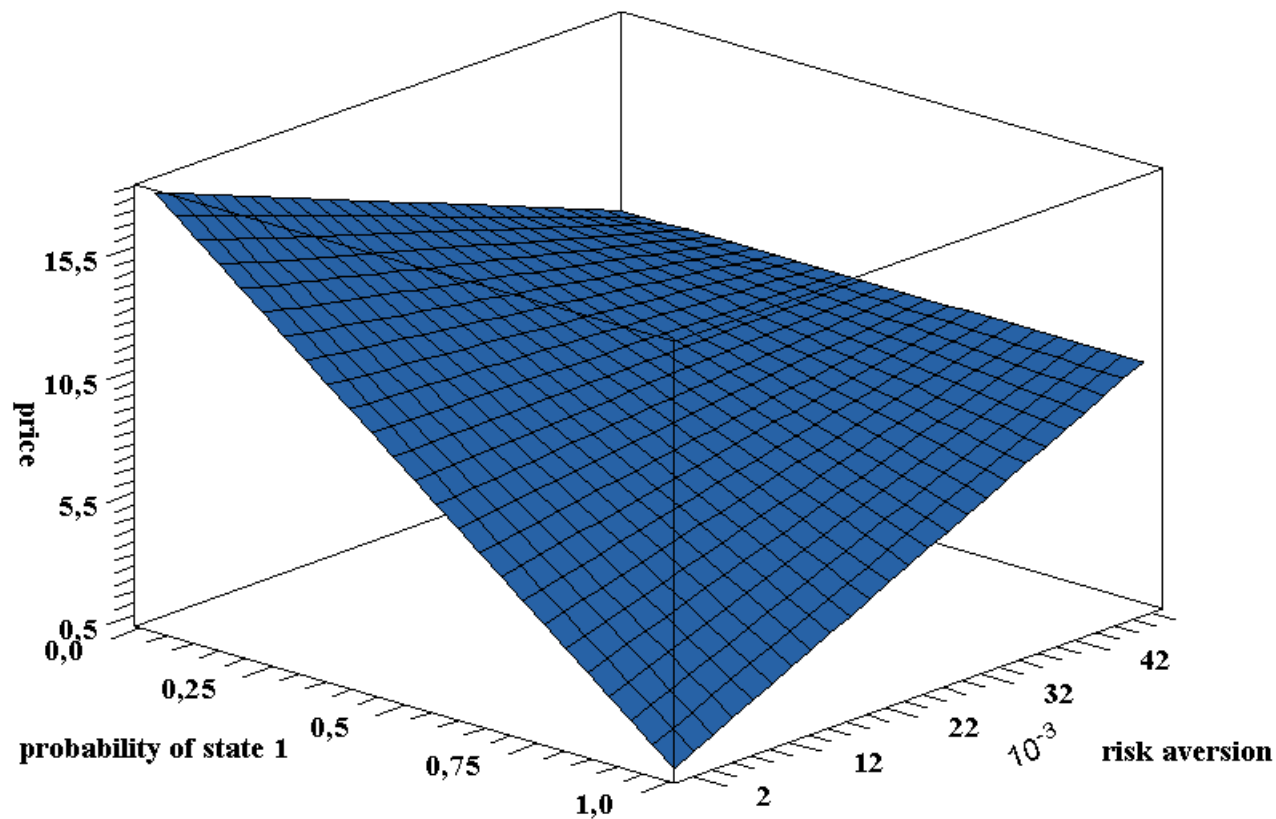
- 1<sup>st</sup> consequence

- The price of the structured financial instrument ***cannot*** be derived from the financial market ***alone***.
    - Investors must value the cash flow discrepancy (Cox/Ingersoll/Ross methodology)

– 2<sup>nd</sup> consequence

- Risk preferences **do** matter
- State probabilities (1/4 or 3/4) **do** matter

- Graphical illustration



– 3<sup>rd</sup> consequence

- The portfolio of “old” loans of the bank **does** matter.



## – Intuition

- Portfolio of “old” loans of a bank

Loans	?	120	80
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- Structured financial instrument

Structured financial instrument	?	0	20
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- Sum of both positions

Loans + structured financial instrument	?	120	100
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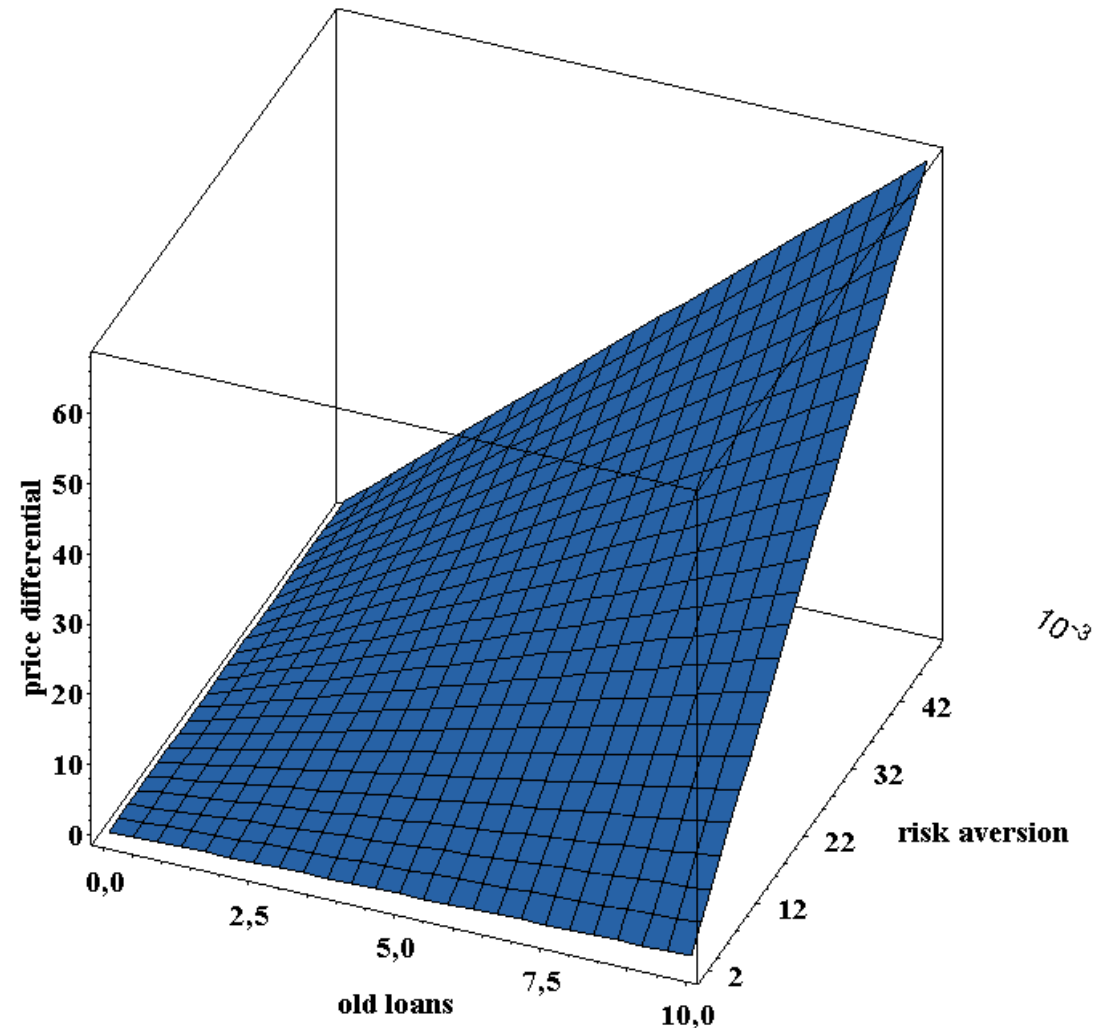
## – Graphical illustration

price of the structured  
financial product *with*  
consideration of the  
portfolio of “old” loans

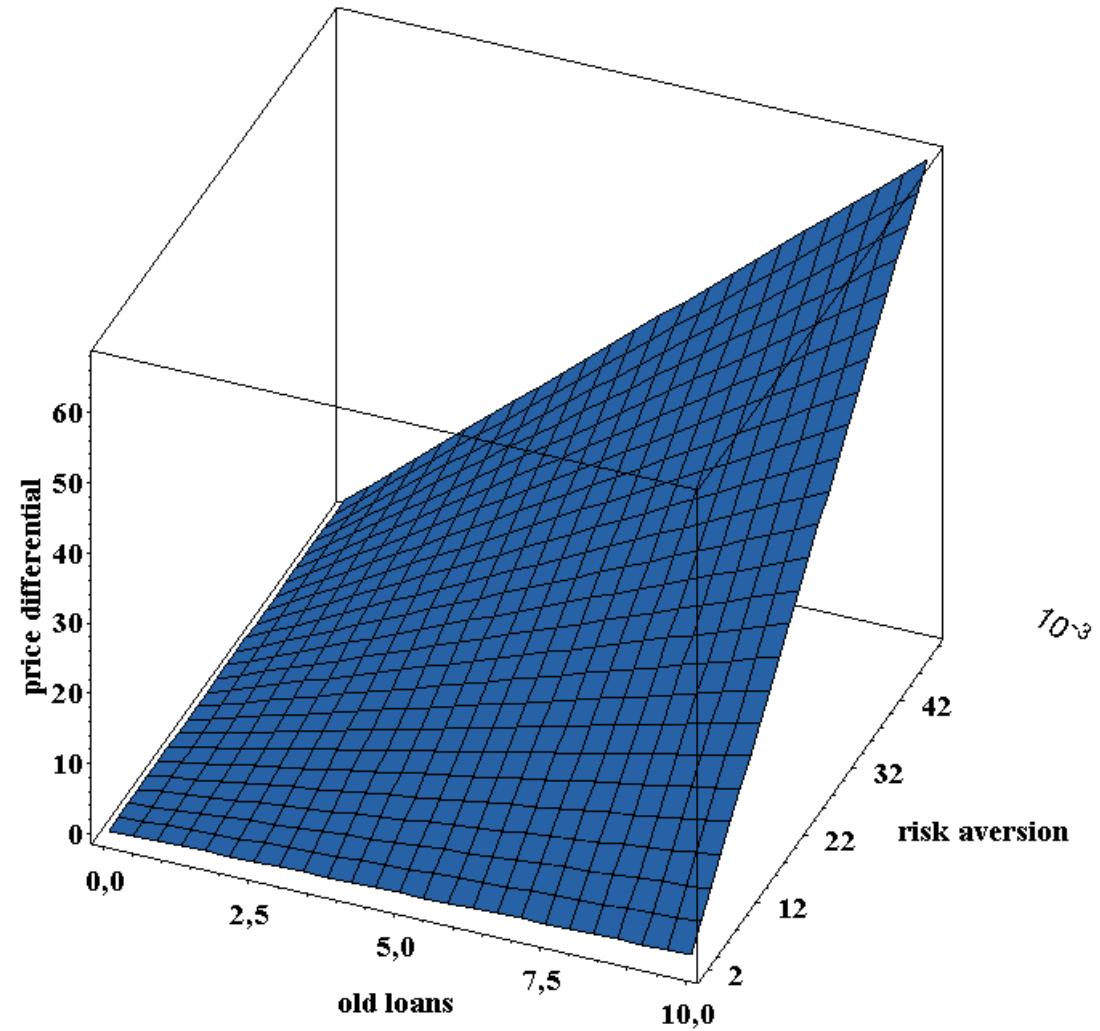
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price of the structured  
financial product  
*without* consideration  
of the portfolio of “old”  
loans

(*stand alone price*)



“good”  
risk





## – Counter-example

- Portfolio of “old” loans of a bank

Loans	?	80	120
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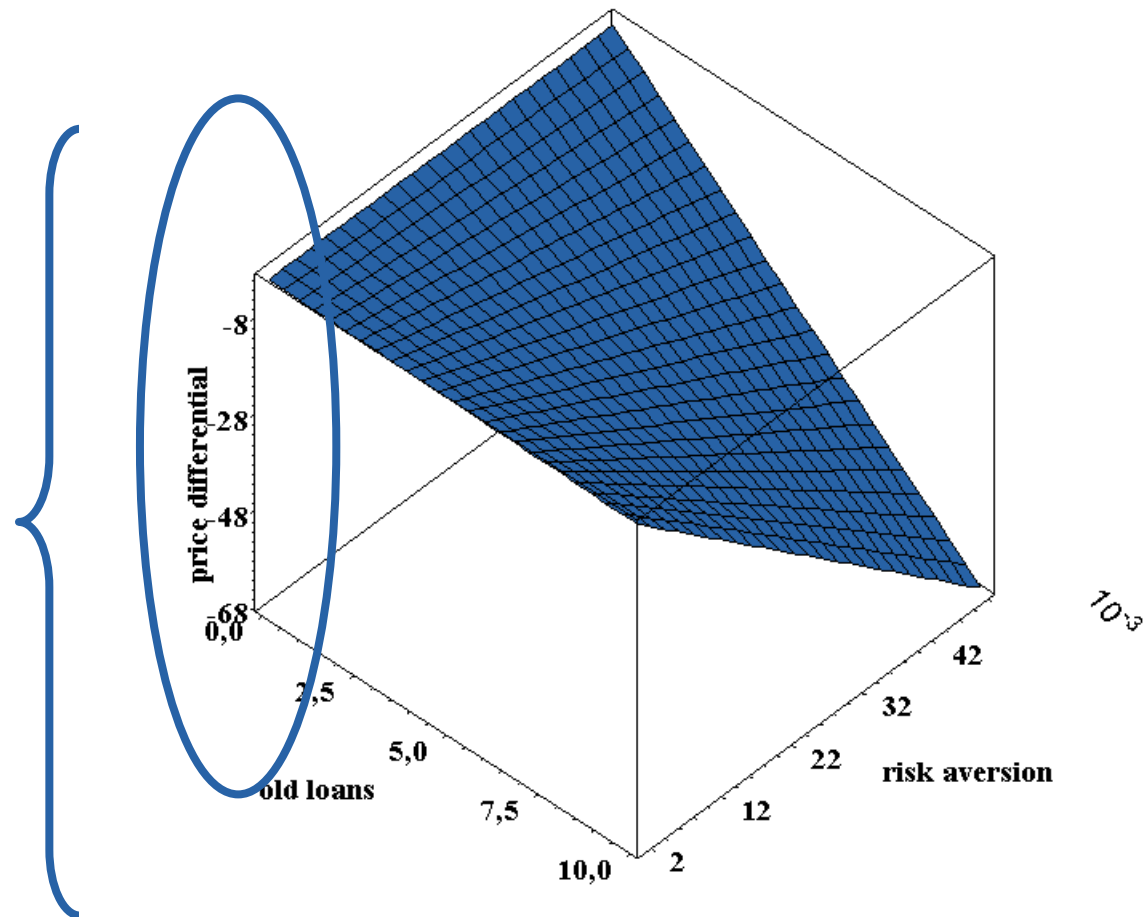
- Structured financial instrument

Structured financial instrument	?	0	20
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- Sum of both positions

Loans + structured financial instrument	?	80	140
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“*bad*”  
risk



## 3 Application

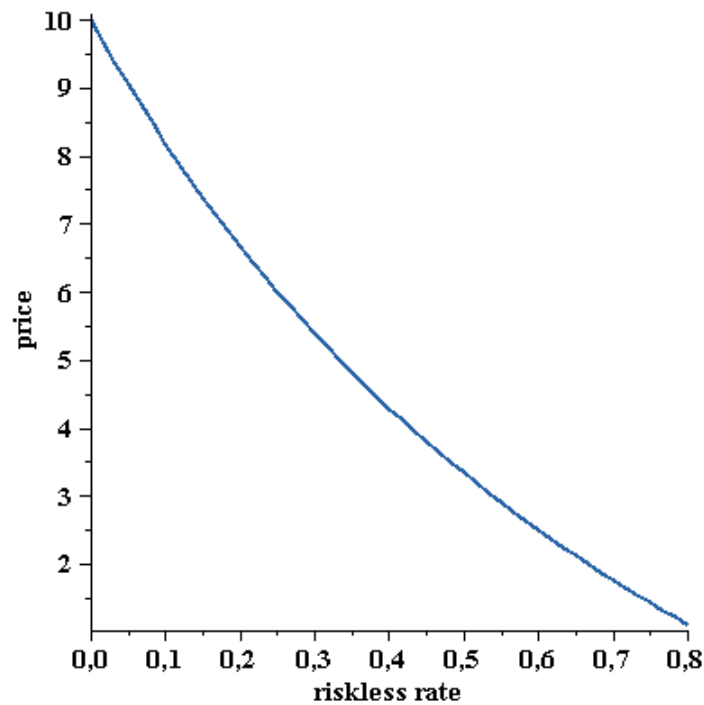
### 3.1 Islamic financial products and interest rate risk

- Introductory example

Structured financial instrument	?	0	20
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- Definition
  - If the price of a financial instrument changes when interest rates change,
  - this product is subject to interest rate risk.

- Dependence of the price of the structured financial instrument on interest rates
  - Duplication possible



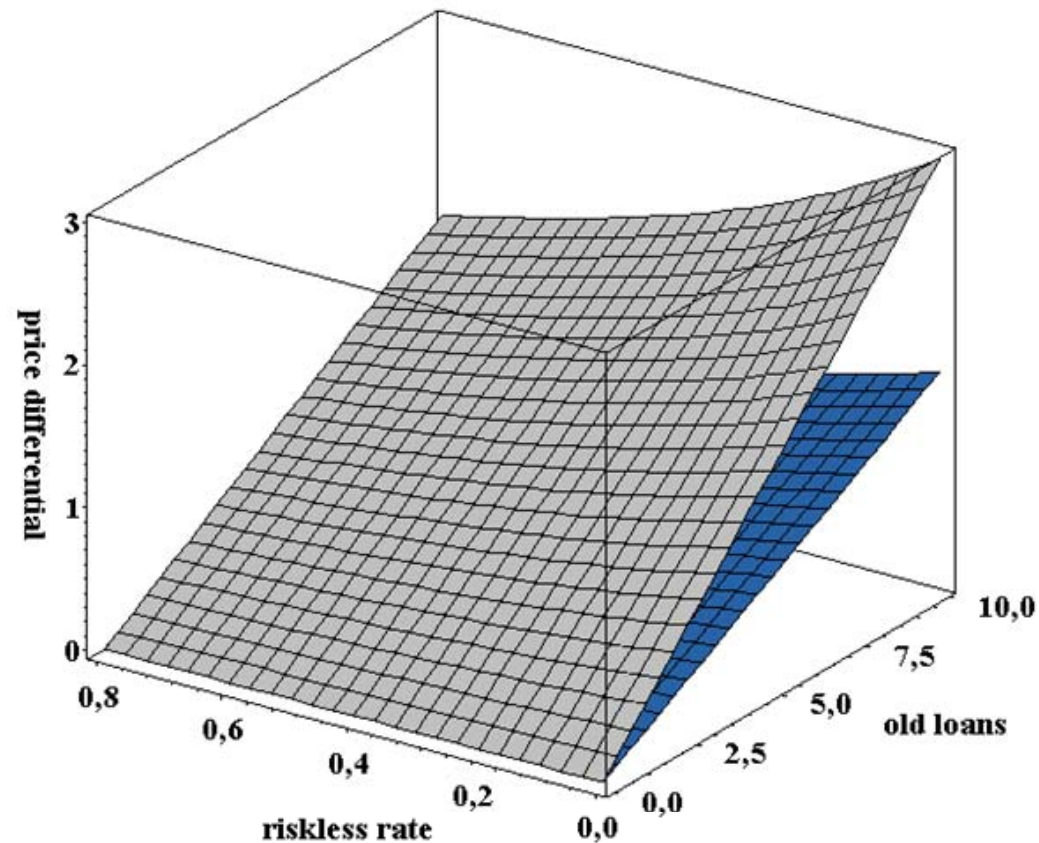
## – Duplication impossible

price of the structured financial product *with* consideration of the portfolio of “old” loans

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price of the structured financial product *without* consideration of the portfolio of “old” loans

(*stand alone price*)



High risk aversion

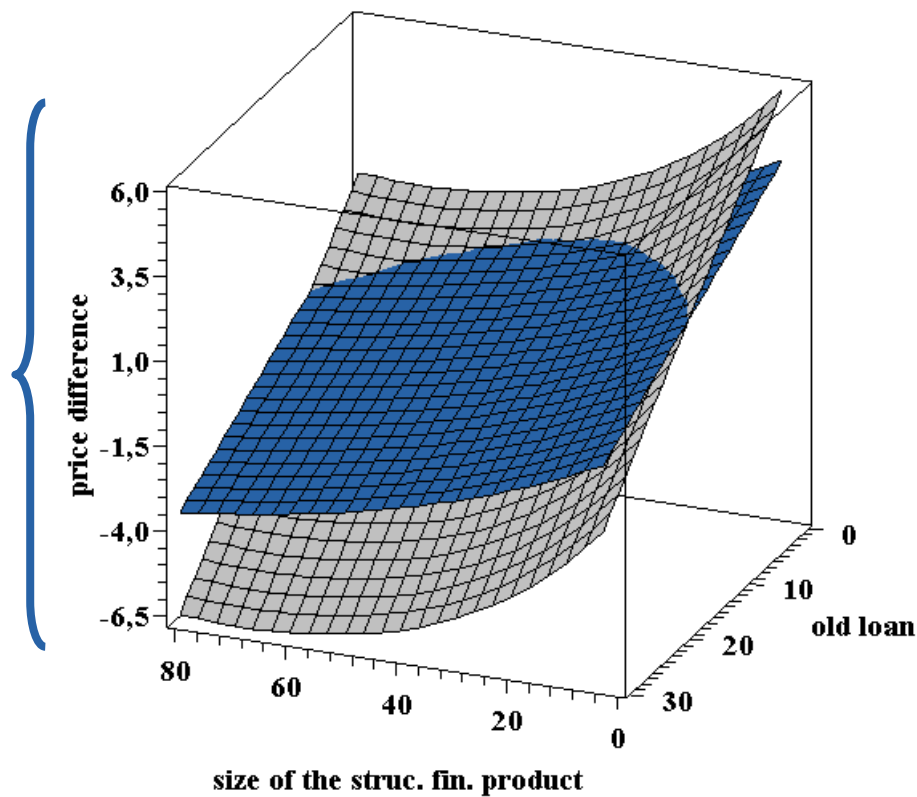
Low risk aversion

- Risk on markets without a riskless asset

Price without

—

Price with  
riskless asset



High risk aversion

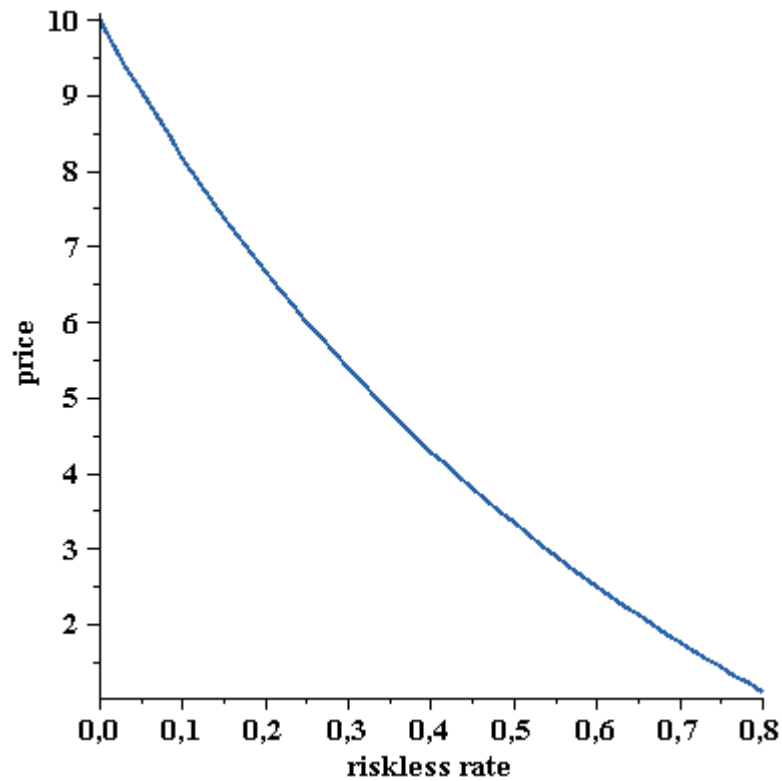
Low risk aversion

## 3.2 Consequences to banking supervision

- Information
  - Duplication ***possible***: information just ***on the cash flow*** of the structures financial product is required
  - Duplication ***impossible***: information on the cash flow of the structured financial product ***as well as*** the bank's "old" loan portfolio is required



- Information on interest sensitivity is needed in both valuation scenarios (duplication possible or impossible).



- Incentive Compatibility
  - Duplication possible: cash flows are obvious
  - Duplication impossible: there is no incentive that will result in true revelation (stand alone price is a bad proxy)

## 4 Conclusion

- Huge losses with structured financial instruments
- Information required to judge the risk of these structured financial instruments
  - Duplication possible: cash flow
  - Duplication impossible: cash flow and bank's "old" loans
  - Interest rate sensitivity

- Banking supervision must actively gather this information.



**Thank you for your  
attention!**