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Behind the Scenes of the Swiss Financial Center

The infrastructure and modeling its risks

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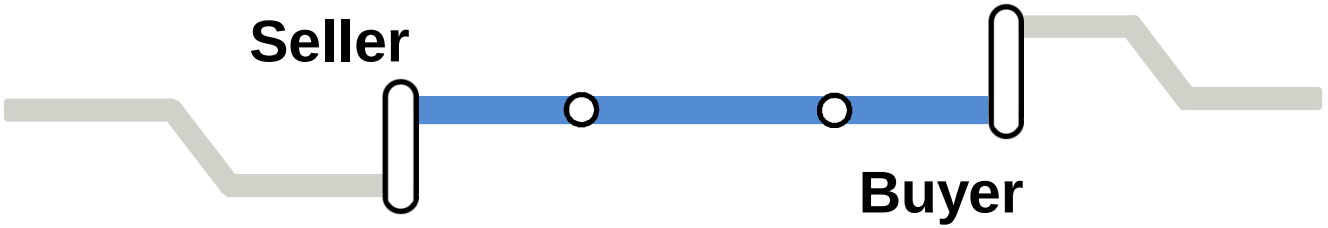
Classification: Public

Agenda

1. The infrastructure of the Swiss financial center

2. Its risks and their quantification

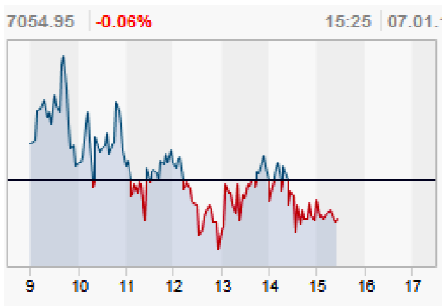
Roughly speaking: what SBB does for people … SIX does for money and securities



SIX, backbone of the Swiss financial center

Cash Transactions

- User-owned
- > 3’500 people
- 25 countries
- AA- Rating



Trading & Indices

Financial Data

Handling of Securities

To illustrate things, let us use the help of Mr. Bernoulli

Jakob Bernoulli

A very famous Swiss mathematician from the 17th century, a helper of actuaries and quants

To illustrate things, let us use the help of Mr. Bernoulli

Let us give him an account and a credit card

Mr. Bernoulli using the SIX infrastructure…

Cash Transactions

- **He pays at a store with his card**
  - 200’000 terminals
  - 24 transactions per second
- **The merchant receives cash from SIX**
  - CHF 200m per day
- **He withdraws cash from an ATM**
  - 10 per second
- **Pre-pays his phone, uses a Giftcard, …**
- **He pays online with his card** (Saferpay)
- **Total: 120 card transactions per second**
- **He sets up e-billing and direct debit**
- **Cash transactions between banks**
  - 20 per second, worth CHF 5m

SIC

Swiss Interbank Clearing

(on behalf of the **SNB**)

Mr. Bernoulli using the SIX infrastructure…

- **He buys shares of the only firm he recognizes from the 17th century…**
  - Orell Füssli (1519, also money printers)
- **He also buys some ETF's, Bonds and collateralized structured products**
  - 5 transactions per second
  - Daily: CHF 4b and 220 new listings
  - 40'000 securities listed
  - Large offer of indices, such as SMI
- **His bank and insurer obtain liquidity from the SNB using repurchase agreements** (Repo)
  - Outstanding CHF 70b during 2008 crisis

Trading & Indices

- **The data is distributed to the world** ····· **Financial Data**
- **Cash is transferred between banks** ····· **Cash Transactions**
- **Securities are transferred between banks** ···· **Handling of Securities**

Mr. Bernoulli using the SIX infrastructure…

- **He reads the financial data and news:**

  - Data on 7 million financial instruments:
    a) Reference data
    b) Market data (prices, indices, etc.)
    c) News and analyses

  - 30’000 price telegrams per second

  - 850 data sources (e.g. exchanges)

Financial Data

Mr. Bernoulli using the SIX infrastructure …

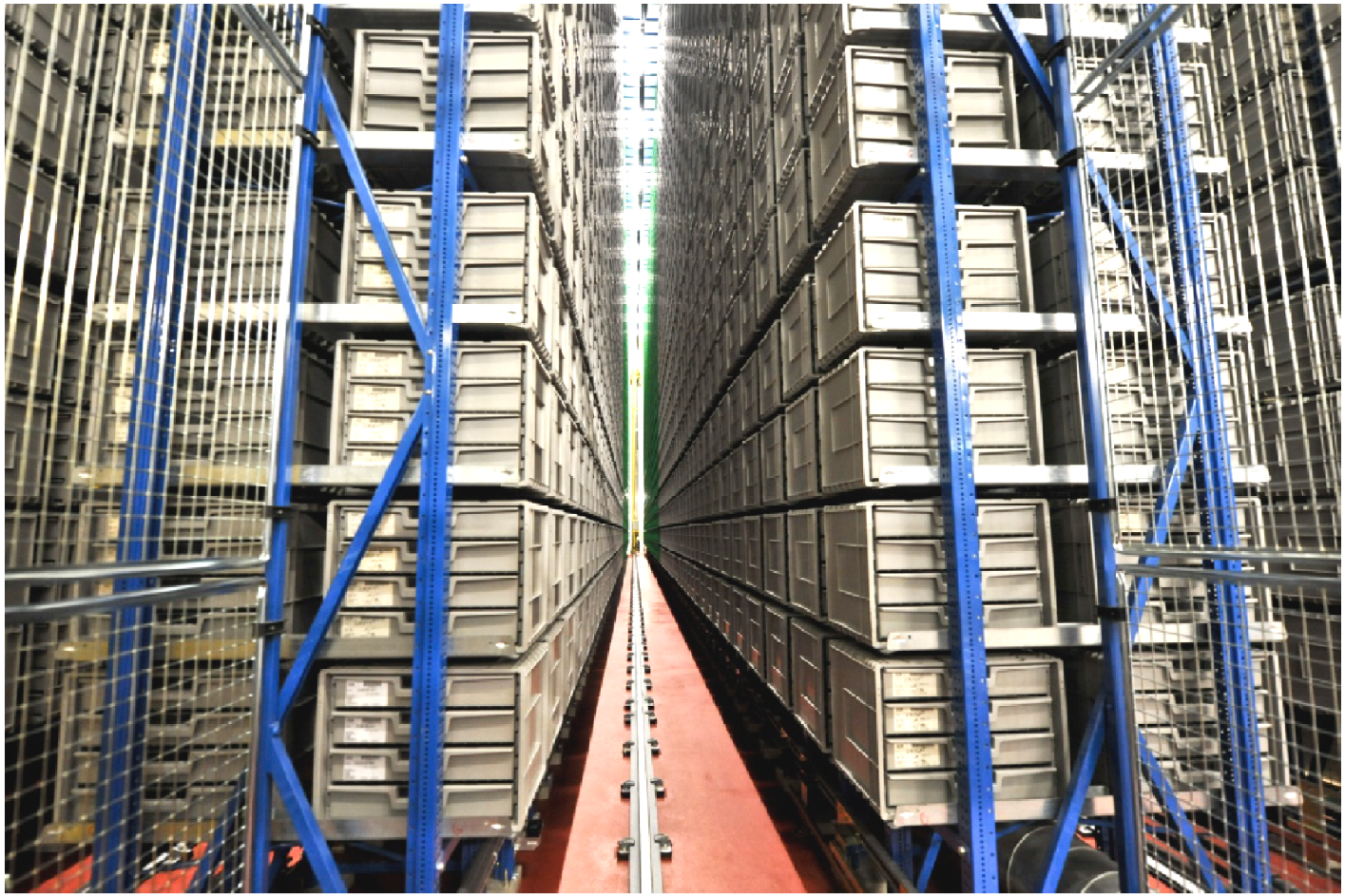
- **The securities he bought are <u>cleared</u> at once**
  - SIX is the central counterparty
  - 15 transactions per second
- **… and <u>settled three days later</u>**
  - SIX transfers cash and securities
  - 2 transactions per second
- **He receives dividends from his shares and coupons from his bonds**
  - 1’500 corporate actions daily
- **He decides to short-sell some shares**
  - Securities lending & borrowing
- **His shares are registered**
  - He is invited for general meetings
- **His assets are (electronically) kept in a safe**
  - CHF 2,5 trillion assets
  - 800 tons of gold & silver worth CHF 10b

“The Swiss Fort Knox”

Handling of Securities

The safe seen from the inside…

The safe seen from the inside (really)



Quiz: what are the risks?

Sample of answers:

~~A)~~ "There are no risks"	Frequent answer, but wrong
~~B)~~ "There are risks, and the largest is called Basel III"	Sorry, you sound like a bad head of risk management at a bank
A) "There are many risks. They create jobs for risks controllers and actuaries"	Actually right!

What are the risks?
In “Cash Transactions”

- **IT-system breaks and most people cannot make card payments**
  - Yes, it happens. Most (in)famous event: 24.12.2001…
- **System is hacked and card information is stolen**
  - Never happened before at SIX. It has happened in other companies.
- **A large online merchant defaults**
  - SIX can be held responsible for delivering paid products not yet delivered...
- **The interbank payment system does not work**
  - There are strict requirements from the SNB, including contingency plans.

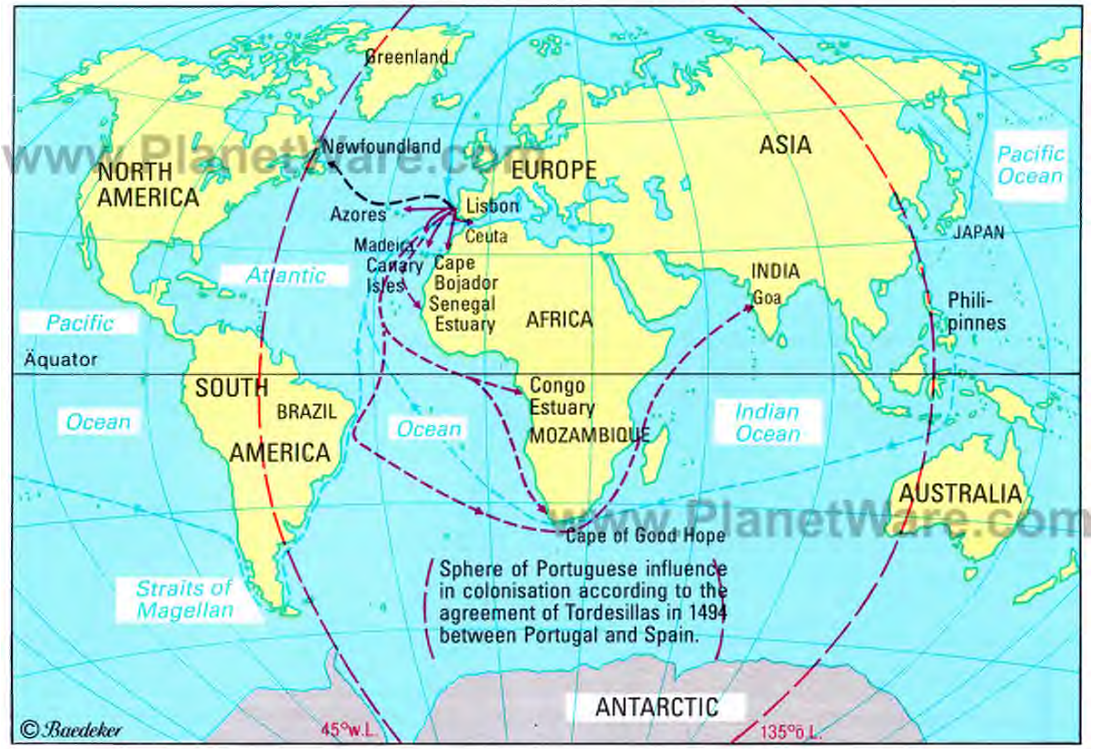
What are the risks?
In “Trading and Indices”

- **The stock exchange does not function**
  - ► It happens. Banks can use other exchange platforms in the meantime.
- **A mistake is done during an IPO**
  - ► Remember Facebook? UBS does.
- **An index is wrongly calculated**
  - ► Potential consequences can be big.
- **Self-regulation is compromised**
  - ► Large reputational effect.

What are the risks?

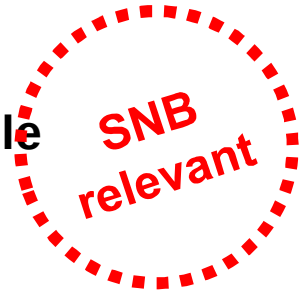
In "Financial Data"

- **The world is split in half between Bloomberg and Thomson-Reuters**
  - ► Something like this happened in 1494 with the "Treaty of Tordesillas"



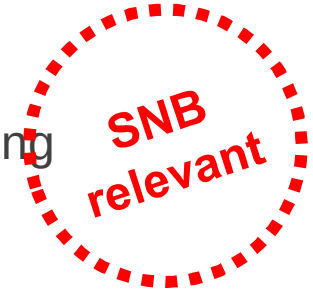
What are the risks?
In "Handling Securities"

- **IT-system breaks and transactions are not possible**
  - ► There are strict requirements from the SNB, including contingency plans.



- **A settlement member defaults**
  - ► If there are outstanding cash positions (credit), then it is nice to have good collaterals to cover them.

- **A clearing member defaults**
  - ► Risk mutualization: the importance of properly computing margin requirements and default fund contributions…



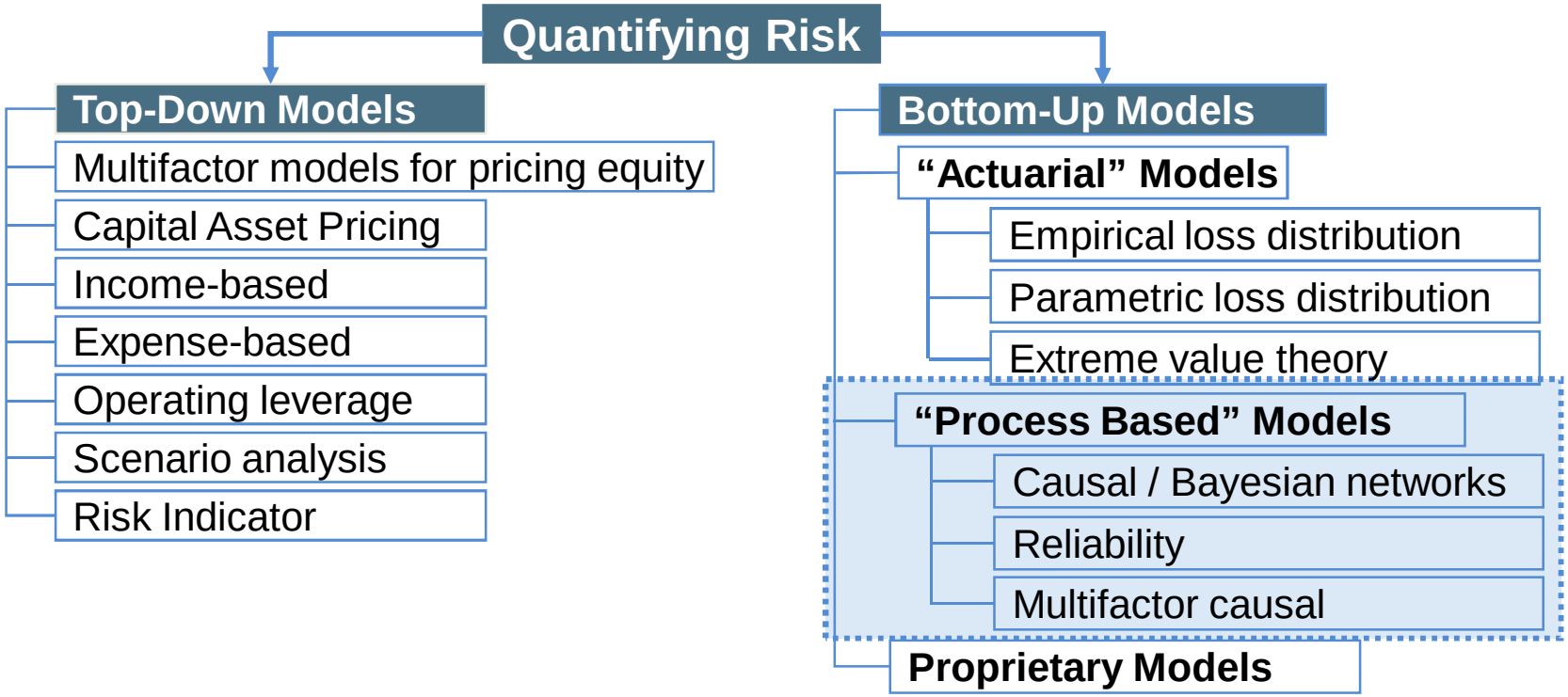
- **A mistake is make in executing a corporate action**
  - ► Correcting the mistake can result in a loss, or a profit.

How (not) to analyze risks?

Afghanistan war: social, political and economical risks

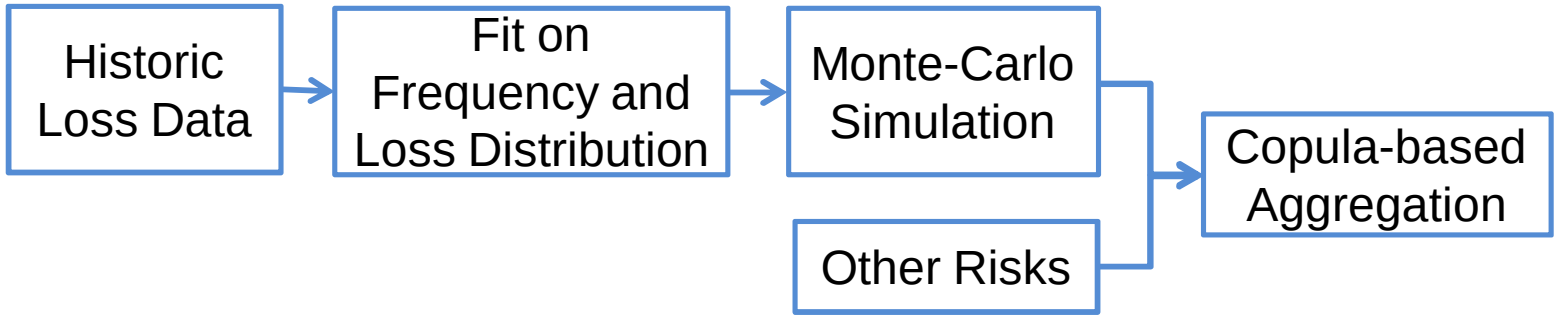
How to analyze risks?

- **Quantification is very useful – it allows to:**
  - Understand better the risk and what the main factors are
  - Track the effect of changes in the business environment
  - Compare and aggregate risks
  - Estimate the required capital, as well as allocate it



“Actuarial” Model

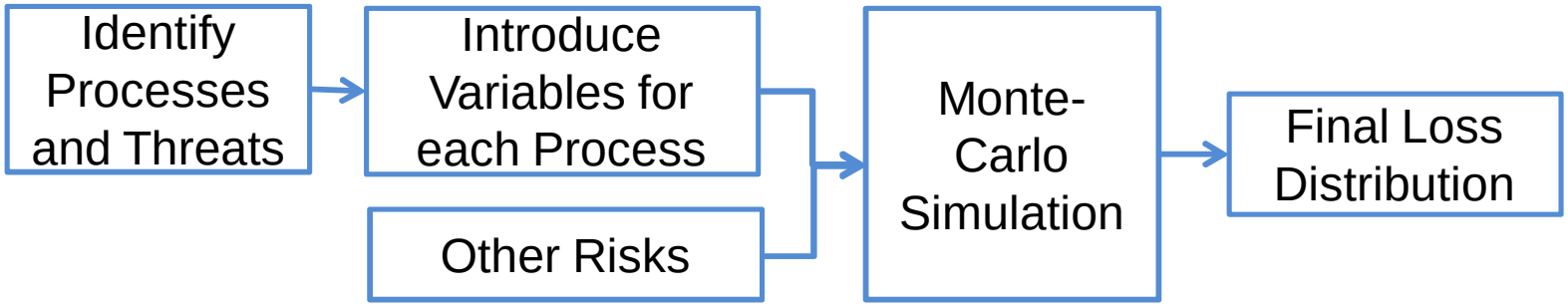
Example: Loss Distribution Approach (LDA)



- **It needs historical data**
  - E.g. insurance claims
- **Copula aggregation can be quite non-intuitive**
- **No direct link with the business environment**
  - Credit spreads, processes, etc. are not visible

“Process Based” Model

Example: Causal Model



- **Driving factor must be identified and calibrated**
  - For instance: default probability from credit spreads
- **Provides a natural frame to introduce correlations**
  - Use common factors. Examples: a market, or default of the same bank across various risks
- **Direct link with the business environment**
  - For instance: improving a process might decrease exposure

Example: Counterparty risk

Reviewed by PRS Experten für Experten

Risk 1 – Liquidity Management in Settlement

Processes and Threats:	**Variables** (example)
Banks have collateralized lines	a_i = **Limits** (CHF 10 milli
The banks use their lines	U_i = **Uniform variable** (0
A bank defaults	B_i = **Bernoulli variable**
Collaterals are sold in market	M_i = **Gaussian variable**

Correlation between defaults

$$Loss = \sum_{i=1}^{N} a_i \times U_i \times B_i \times M_i \quad \text{(if } M < 0\text{)}$$

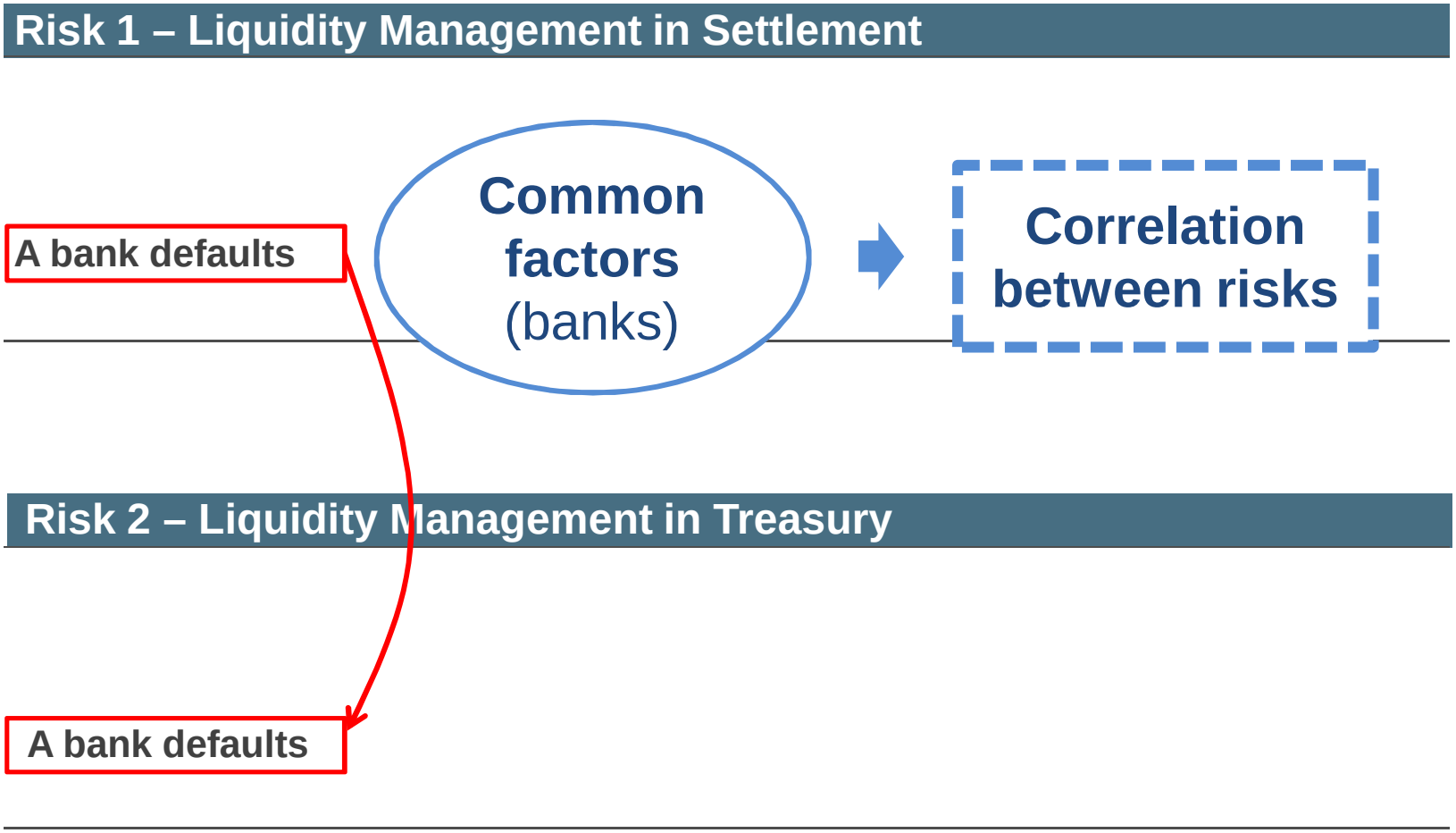
Risk 2 – Liquidity Management in Treasury

Processes and Threats:	**Variables** (example)
Treasury has various bank accounts	b_j = **Limit** (CHF 10 millio
The treasurer deposits cash in accounts	D_j = **Triangular variable** ion)
A bank defaults	B_j = **Bernoulli variable**)
Recovery after liquidation	R_j = **Recovery rate** (0%

Correlation between defaults

$$Loss = \sum_{j=1}^{M} b_j \times D_j \times B_j \times (R_j - 1)$$

Example: Counterparty risk



Example: Operational risk

- **Mistakes from corporate actions**
  - There is historic data (a requirement from the regulators)
- **Processes are well understood, including some risky ones**
  - Usage of external data
  - Manual operations
  - Time pressure

Example: Operational risk

Corporate Actions team in action…

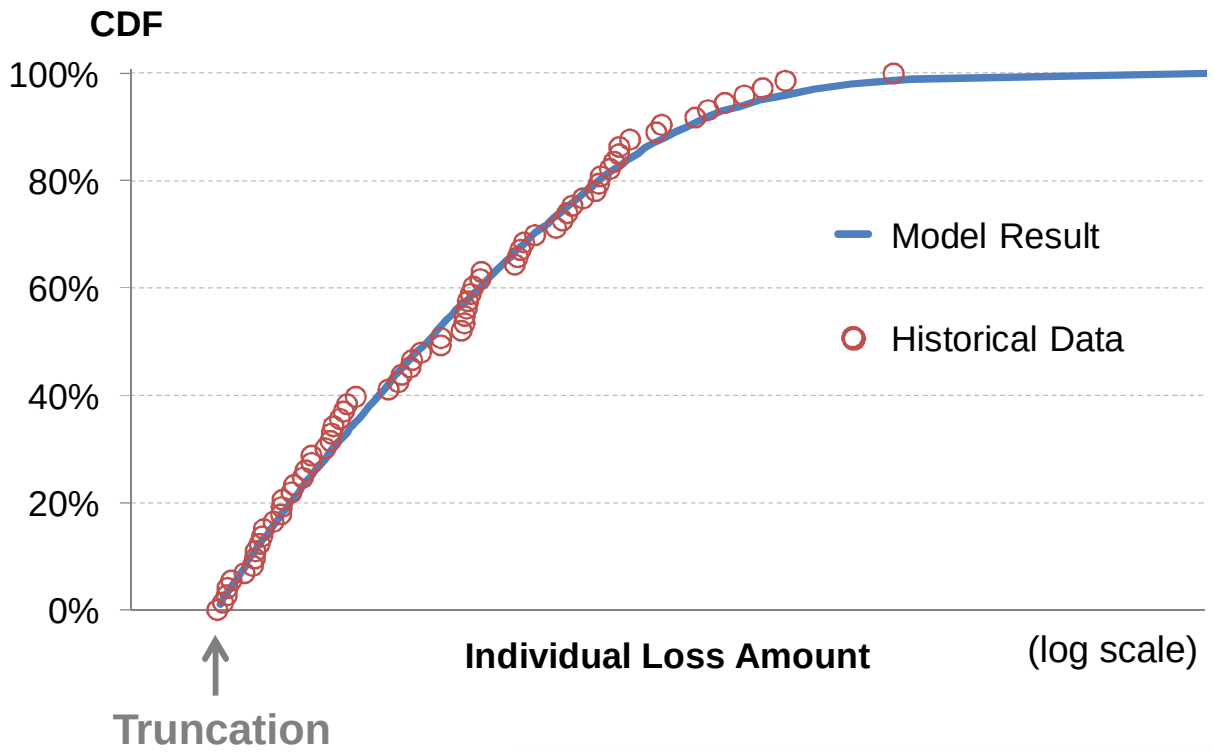
Example: Operational risk

Risk 3 – Operational Mistakes in Corporate Actions

Processes and Threats:	**Variables** (example)
Size of a corporate action	A_i **= Log-normal variable** (m=10, s=3)
Yearly mistake frequency	N **= Poisson variable** (λ=10)
Relative size of a mistake	S_i **= Uniform variable** (a=0, b=7%)
Instruments are sold/bought	M_i **= Gaussian variable** (μ=0%, σ=5%)

Loss (or profit) =

$$\sum_{i=1}^{N} A_i \times S_i \times M_i$$



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Thank you for your attention.

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