

Contagion

Prof. dr. Roger J. A. Laeven

September 6, 2012



CONTAGION

Challenges in Risk and Insurance

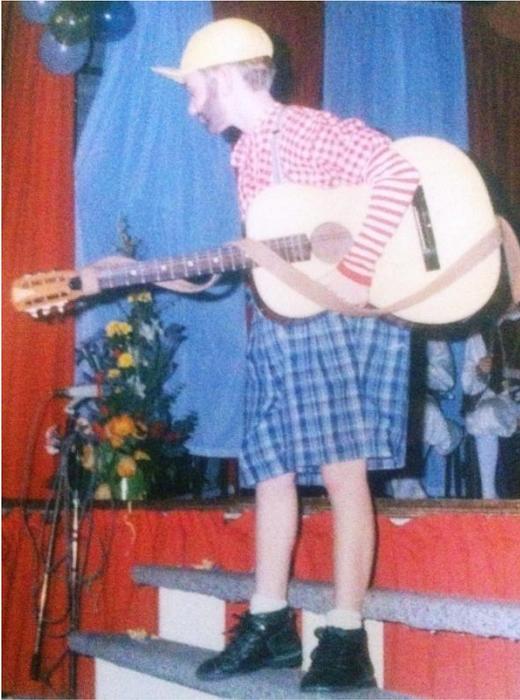
Inaugural Lecture

delivered upon appointment to the chair of
Full Professor of Risk and Insurance
at the University of Amsterdam
on Thursday 6 September 2012

by

Prof. dr. Roger J. A. Laeven

1988



- *Roger "Urbanus" Laeven*

2012



2012



- *Sit back, relax and enjoy your stay.*

September 21, 2005



- *Essays on Risk Measures and Stochastic Dependence, with Applications to Insurance and Finance.*

September 6, 2012



- *Contagion: Challenges in Risk and Insurance.*

Outline

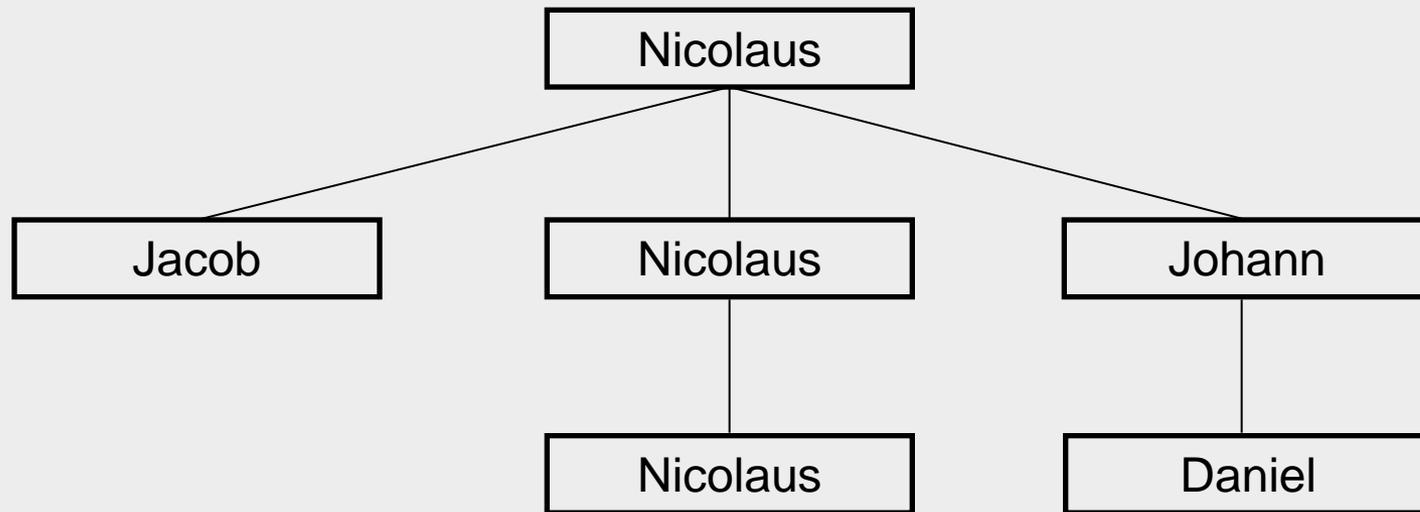
- A Brief History of Risk and Insurance
- Basic Principles of Risk and Insurance
- Risk and Insurance: Stochastics and Economics
- Challenges in Risk and Insurance
- Future of Risk and Insurance
- *Tot Slot*

Jacob (James) Bernoulli



- 1691
- Law of Large Numbers
(Wet van de Grote Aantallen)

Excerpt of the Bernoulli Family Tree



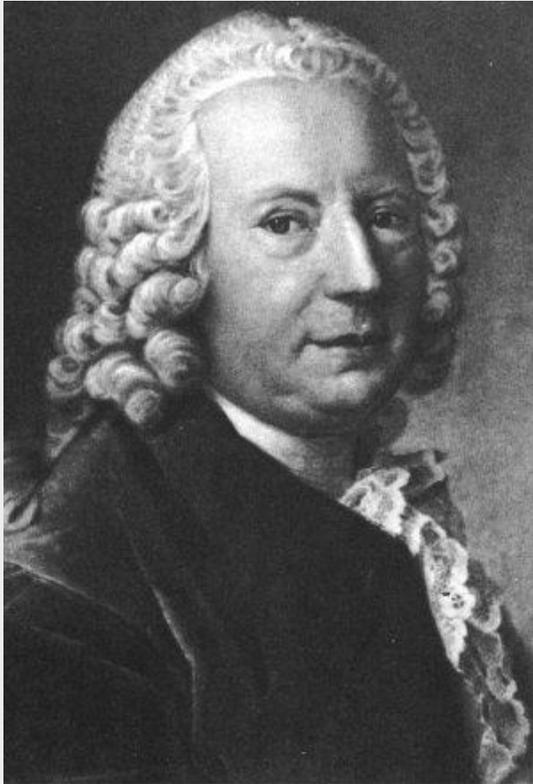
Jacob Bernoulli

- Law of Large Numbers:
“The average loss in an expanding pool of risks eventually becomes certain (or predictable).”
- Pooling risks can serve as a basic risk mitigation technique.

Jacob Bernoulli

- *Acta Eruditorum*
- Correspondences with Leibniz
- *Monumentum aere perennius* (Horace)
(Een monument duurzamer dan brons)

Daniel Bernoulli



- 1731
- Risk Measurement and Utility

Daniel Bernoulli

- Expectations are no proper descriptions of risk.
- St. Petersburg paradox.
- Subjective elements (utilities).

Outline

- A Brief History of Risk and Insurance
- **Basic Principles of Risk and Insurance**
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Law of Large Numbers

- Implications poorly understood.
- “The average loss in an expanding pool of risks eventually becomes certain (or predictable).”
 - Average not aggregate
 - Pooling large numbers of risks

Car



- Frederike Laeven, 3 years

Example I: 1 car

<i>Probability</i>	99%	1%
<i>Loss</i>	EUR 0	EUR 10,000

Pool of Cars



- Matthijs Laeven, 5 years

Example I: 1,000 cars

<i>Probability</i>	99%	1%
<i>Loss</i>	EUR 0	EUR 10,000

<i>Probability</i>	99.999%	0.001%
<i>Average Loss</i>	\leq EUR 250	$>$ EUR 250

Example I: 1,000,000 cars

<i>Probability</i>	99%	1%
<i>Loss</i>	EUR 0	EUR 10,000

<i>Probability</i>	99.999%	0.001%
<i>Average Loss</i>	\leq EUR 104.26	$>$ EUR 104.26

Lesson

- “While the loss of a single individual may be highly unpredictable, the average loss, averaged over an expanding pool of risks, eventually becomes predictable: EUR 100.”

Fallacies

- Average versus Aggregate
- Independent versus Dependent
- Infinite versus Finite

Example II: Average vs. Aggregate (1,000 cars)

<i>Probability</i>	99.999%	0.001%
<i>Average Loss</i>	\leq EUR 250	$>$ EUR 250

<i>Probability</i>	95%	5%
<i>Aggregate Loss</i>	\leq EUR 150,000	$>$ EUR 150,000

Vulcano



- Simon Laeven, 7 years

Example III: Independent vs. Dependent

<i>Probability</i>	99%	0.9%	0.1%
<i>Loss</i>	EUR 0	EUR 10,000	EUR 10,000

Similar to Example I:

<i>Probability</i>	99%	1%
<i>Loss</i>	EUR 0	EUR 10,000

Example III: Independent vs. Dependent

<i>Probability</i>	0.1%
<i>Average Loss</i>	EUR 10,000

Not similar to Example I:

<i>Probability</i>	99.999%	0.001%
<i>Average Loss</i>	≤EUR 104.26	>EUR 104.26

Independent vs. Dependent

Examples of Systematic Insurance Risks:

- Longevity
- Interest rate

Infinite vs. Finite

- “The expanding pool of risks, eventually pooling infinitely many risks, only exists in the mathematician’s imagination.”

Basic Principle?

- Pooling of risks does not lead to risk reduction on the aggregate level of the pool.
- Why is the Law of Large Numbers is at the core of risk and insurance?



???

Owners: Risk Pooling and Risk Spreading



- Matthijs Laeven, 5 years

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Fundamental Questions

- How to measure risk?
- How to price risk?
- How to deal with dependences between risks?

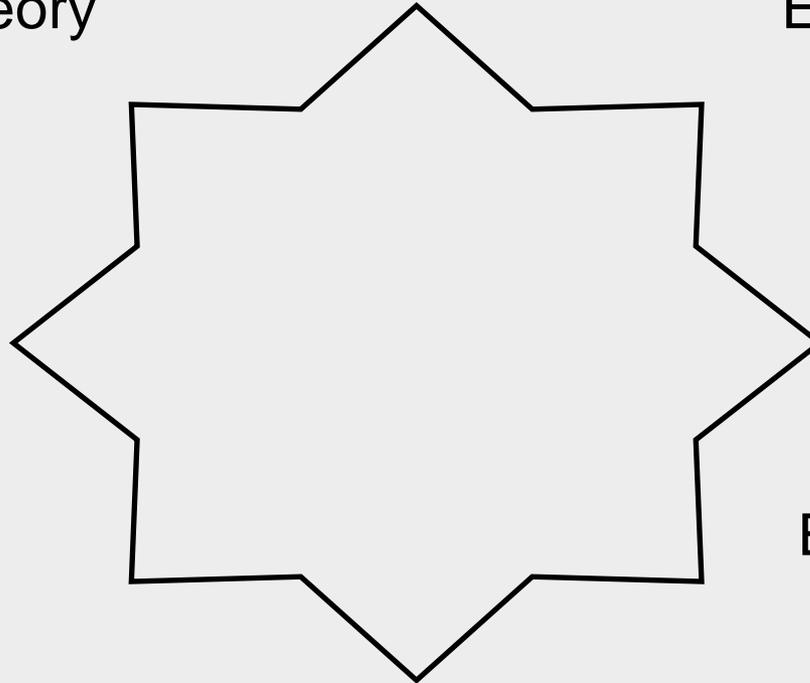
Risk and Stochastics: Idea and Language*

Probability Theory

Mathematical
Statistics

Financial
Mathematics

Insurance
Mathematics



Economic Theory

Financial
Economics

Insurance
Economics

Econometrics

*Source: Norberg

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Risk Measures

- Axiomatic characterization:

Economic properties of risk measures



Mathematical representation of risk measures

Risk Measures

- Implications for
 - Risk management and capital requirements;
 - Pricing in incomplete markets; and
 - Portfolio choice and asset allocation.

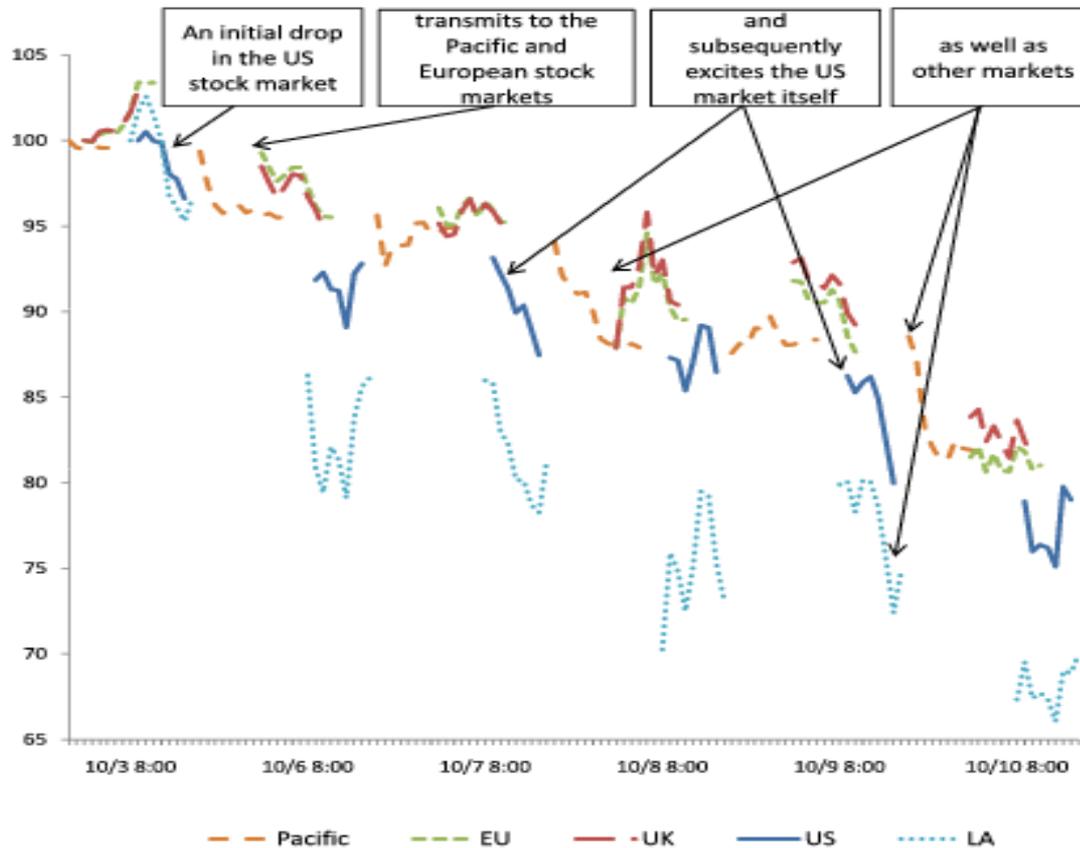
Contagion

- Linguistically, contagion is synonymous with infection.
- Main challenge in Risk and Insurance.

Contagion

- Transmission of shocks takes place:
 - in **space** (across countries or regions of the world)
 - and
 - in **time** (successive shocks in affected countries)

Contagion



- Shocks generated from our model

self-excite and **cross-excite**

mimicking the patterns in the data.

Contagion

- Earthquake analogy.
- *Non in cauda sed in caudis venenum* (Laeven)
(Niet in de staart maar in de staarten zit het venein)

Contagion

- Implications for
 - Risk management and capital requirements;
 - Pricing; and
 - Portfolio choice and asset allocation.

- “This matters because the risk management technique of diversification fails to be rewarding when it is needed most urgently.”

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Insurers and Pensions

- “Against this backdrop, there are important opportunities for insurers to develop transparent and intelligent pension contracts, with unconditional promises and guarantees.”

Insurer Solvency and Supervision

- “The time dimension should be acknowledged and more explicitly incorporated in solvency supervision.”

Education in Risk and Insurance

- “Integrated approaches to Risk and Insurance, and specifically Integrated Risk Management, will become a central part of the education programs.”
- Amsterdam Executive MSc Insurance Studies
- MSc Actuarial Science and Mathematical Finance
- Amsterdam Executive MSc Actuarial Science

Education in Risk and Insurance

- Actuarial Society (AG-AI)
- Tinbergen Institute Graduate School

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Contagion

- “Financial contagion: crucial challenge and exciting research.”
 (“Besmettingsgevaar in financiële markten: cruciale uitdaging en aanstekelijke problematiek.”)

Enjoying Modern Actuarial Risk Theory



- *Simon, Matthijs en Frederike Laeven.*



Full text

Full text of the inaugural lecture is available from:

<http://www.rogerlaeven.com/>

(then under Miscellaneous -> Inaugural Lecture)