



Institute of Actuaries of Australia

# 5th Financial Services Forum

*Renovating the Financial System*

# 2010

13 and 14 May 2010 – SYDNEY

## **Dysfunctional Insurance Systems**

**Shauna Ferris**

Actuarial Studies Department,  
Macquarie University  
[Shauna.Ferris@mq.edu.au](mailto:Shauna.Ferris@mq.edu.au)

## Introduction

- What caused the Subprime Debt Crisis?
  - Moral Hazard, Asymmetric Information, Adverse Selection, Agency Risk, Information Costs, Systemic Risk, Underwriting Cycle, Model Failure, Conflicts of Interest, Capital Requirements, Regulatory Failure, etc etc.
- What caused the Shipping Crisis in 1860 ?
  - Moral Hazard, Asymmetric Information, Adverse Selection, Agency Risk, Information Costs, Systemic Risk, Underwriting Cycle, Model Failure, Conflicts of Interest, Capital Requirements, Regulatory Failure, etc etc.

## Objectives

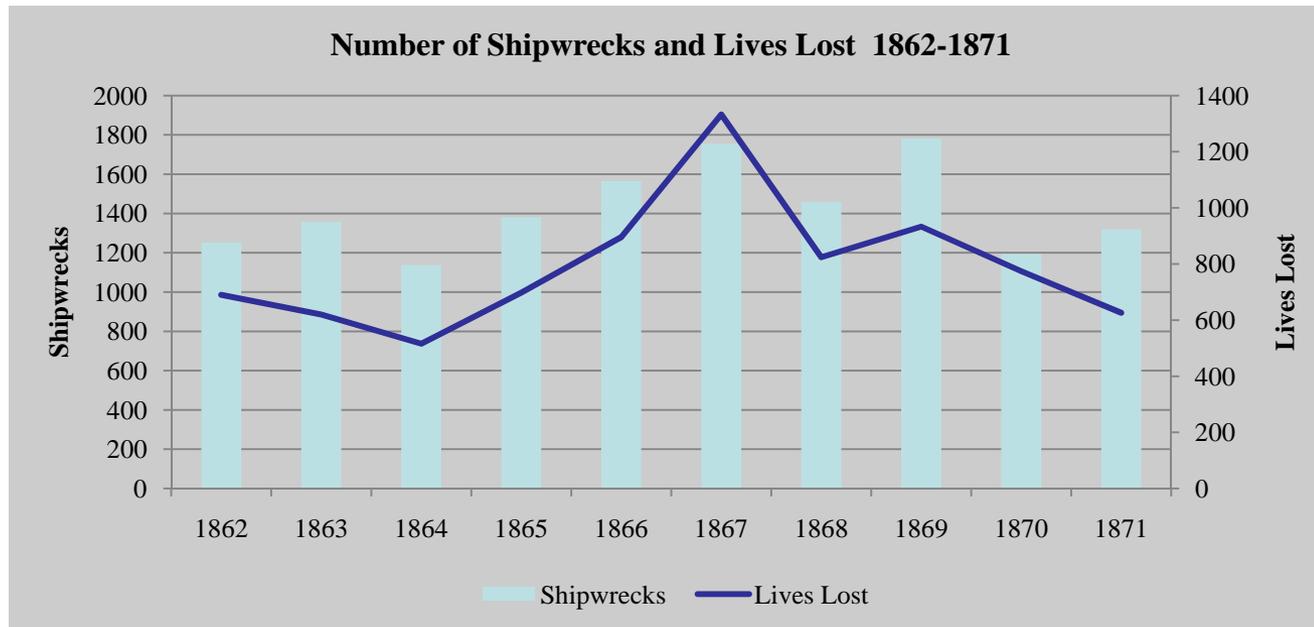
- Build a model of the simpler case
- Gain some insight into how and why the system doesn't work, i.e. symptoms of a dysfunctional insurance system
- Consider the remedies adopted in 1870s (what worked?)
- Use the model to evaluate proposed solutions

## The Loss of the London (1866)

### Bottle with a Message

- *“Farewell, father, brother, sisters and my Edith...  
Reason – ship overweighted with cargo...  
Water broken in...  
Storm, but not too violent for a well-ordered ship....  
God bless my little orphan.”*
- *Q. Why was it so overloaded ?*
- *A. The ship was fully insured....*

## British Shipping Industry 1860s



- Thousands of Lives, Millions of Pounds

- Why ?



- Many sailors understood the connection between insurance and death.
  - *“There was a time when greed and crime did cruelly prevail*
  - *And rotten ships were sent on trips to flounder in the gale;*
  - *When worthless cargoes, well-insured, would to the bottom go,*
  - *And sailors lives were sacrificed that men might wealthy grow.”*
- 1873 “***Our Seamen***” by Samuel Plimsoll
  - An analysis of the financial incentives (especially insurance) which led to an increase in systemic risk in the shipping industry.

## Taking on More Risk

- **Ship-owners**

- Overloading
- Cost-cutting on crew and maintenance
- Re-Construction: increases load, but reduces stability

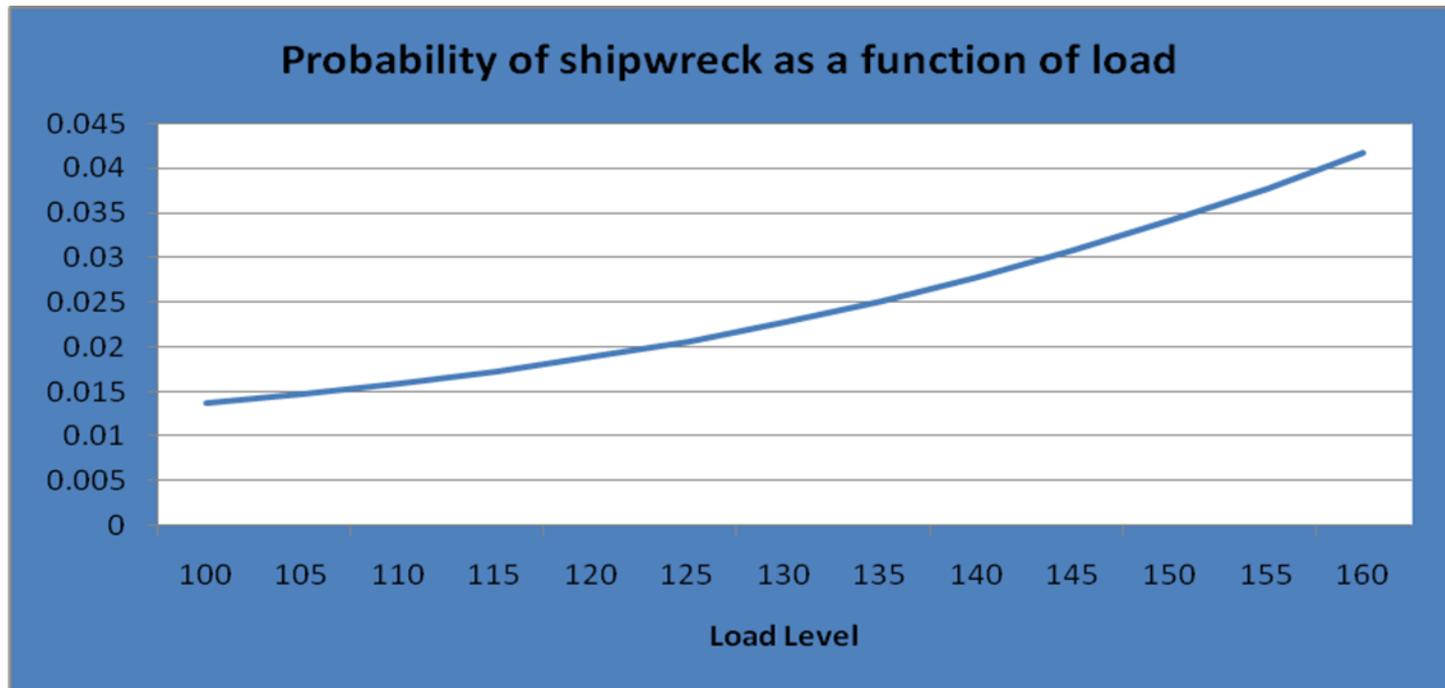
- **Home Lenders**

- Overloading (LTV, RTI)
- Cost-cutting (Low-doc, property valuation)
- Product Design (ARMs & Negative amortisation)

Moral Hazard increases whenever the insured has a great deal of control over the level of risk.

## Model 1: The Risk Function $q(L)$

**“Load” = all risk factors controlled by the insured**





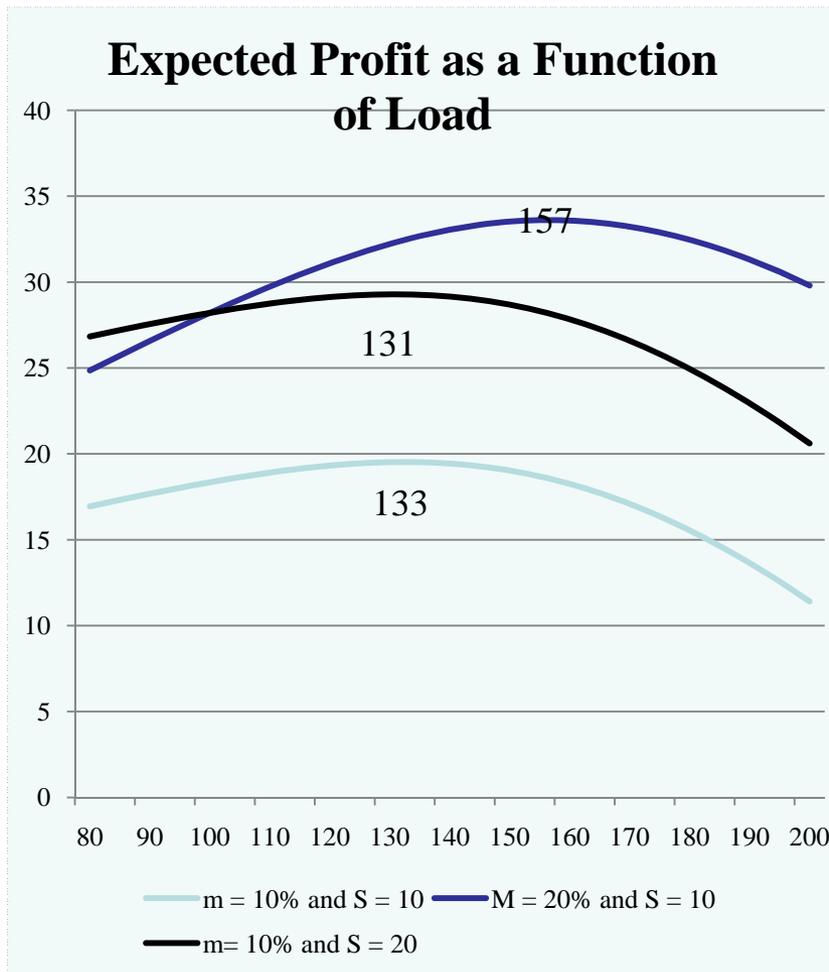
## Q. Why did Ship-owners overload?

- *“When you consider how small an addition to the fair load of a ship will augment the profits of a trip 25%, and even 50%, you will easily see how great was the temptation, especially in settled weather, to add the extra weight.”*
- *LEVERAGE: “When freights run low, the margin for profit over expenses is small; it may take nine-tenths of the cargo to pay the costs; an addition, then of only 10% to the weight of the cargo will double the profit, and 20%, which will still leave the ship in trim difficult to find fault with, will treble the earnings; and when we consider the enormous advantage this gave to the reckless, and the temptation to even those who disapproved of the practice to follow it in self-defence, it is really wonderful to me that the practice should now be, as it undoubtedly is, confined to only a section of the trade. “*

## Model : The Profit Function

- The ship-owners' decision on the load level will be affected by the profits he can make by overloading.
  - He owns a ship **S**, borrows **L** to buy goods,
  - Make profit margin of **m** per unit Load if trip is successful, repay **L**
    - Wealth = **S + mL**                      probability  $1-q(L)$
    - Wealth = **- L**                              probability  $q(L)$
    - (No “insolvency put”)
- Moral Hazard increases when the insured controls the risk AND he can make large profits from increasing the risk level

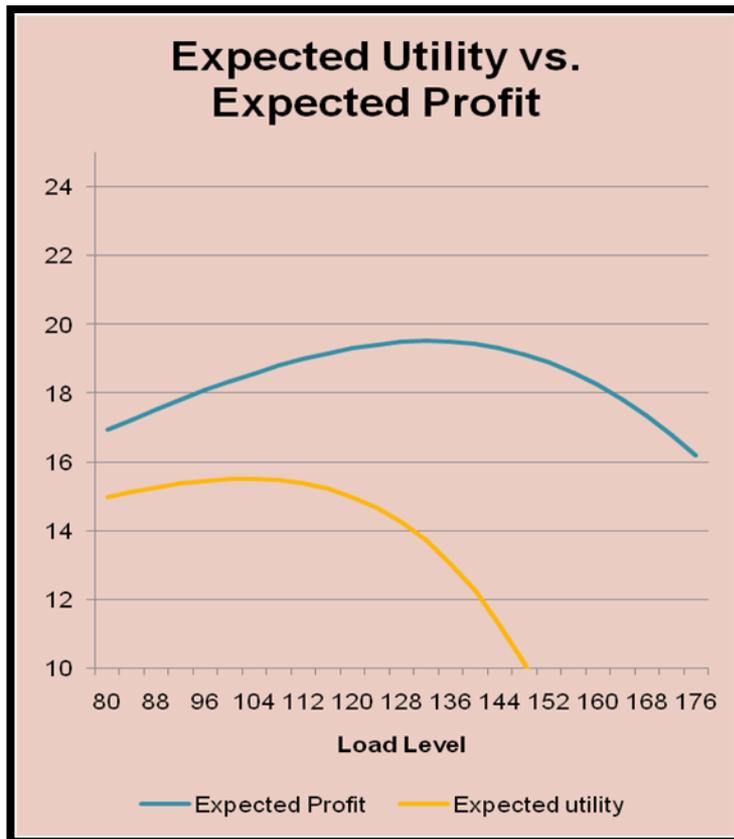
## Profit Maximisation ?



- Optimum Load to maximise  $E[\text{Wealth}]$
- 133 (m = 10%, S = 10)
- 131 (m = 10%, S = 20)
- 157 (m = 20%, S = 10)



## Risk Aversion ?



- Load of 133 has 2.5% probability of shipwreck
- Too risky !
- Apply an exponential utility function
- Parameter chosen to produce “safe” load level of ~ 100
- Maximum  $E[W]$  :  $L= 133$
- Maximum  $E[U]$  :  $L= 103$



## Diversification Benefits?

- **IF** the ship-owners can reduce risk, by investing in a diversified portfolio (e.g. by owning 5% of 20 different ships) this changes the risk return trade-off.
- Optimum Load Level increases
  - Plimsoll : fleet owners taking more risk...
- **BUT** the diversification benefit depends on the correlation between the risks

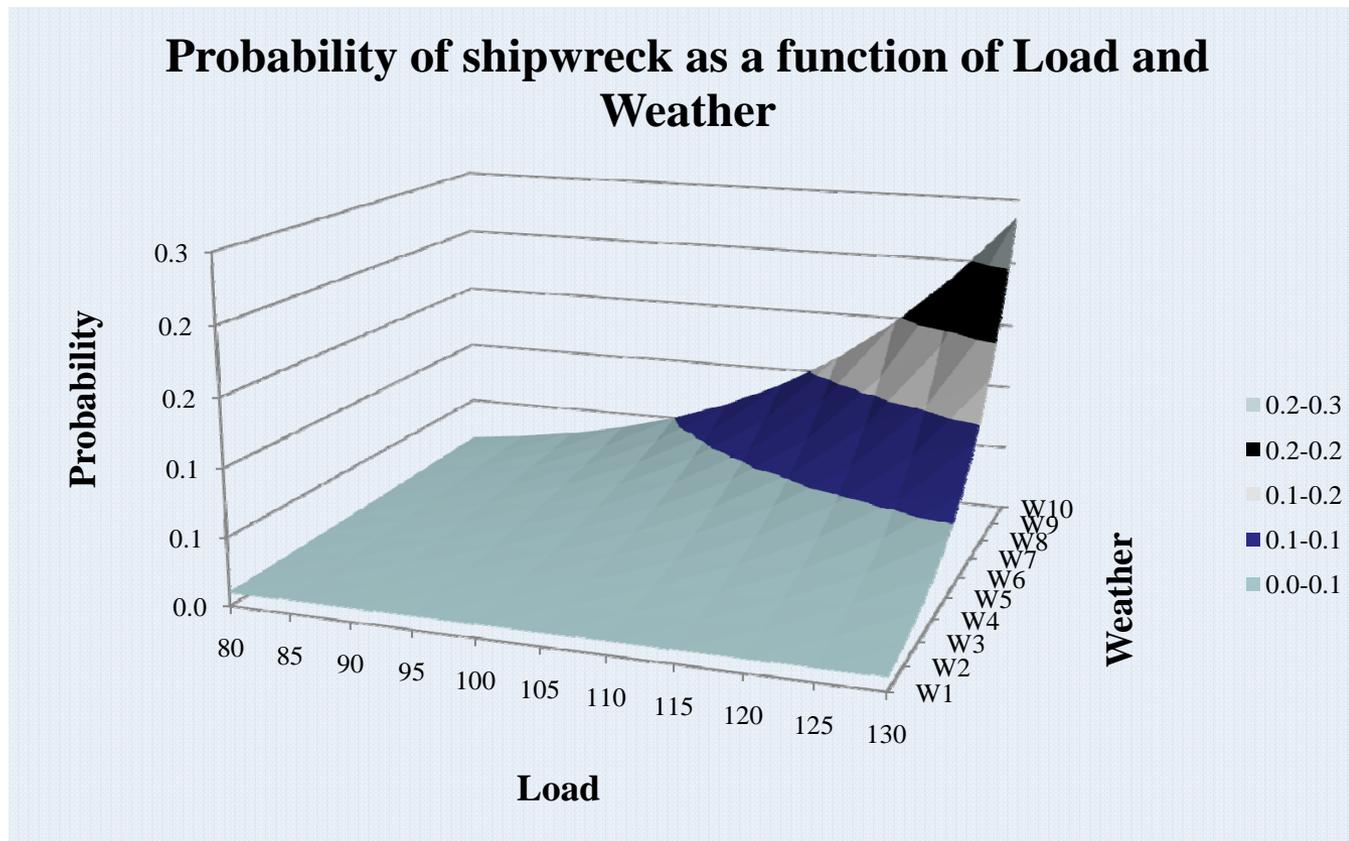


## System-wide Risk Factors

- **Shipwreck Risk**
- Varies over time
- Depends on the **weather**
- Weather affects all ships at the same time
- But does not affect all ships equally
- Overloaded ships are much more likely to sink in bad weather

- **Default Risk**
- Varies over time
- Depends on the **economy**
- The economy affects all loans at the same time
- But does affect all loans equally
- Sub-prime loans are more likely to default in economic downturns

# Model: “Load” & “Weather” Interaction





- The Load/Weather interaction means that risks are **correlated**.
- **Overloaded** ships have a **higher** correlation than safely loaded ships
  - (like high-beta shares in MVPT).
- Therefore diversification benefits are limited – **ESPECIALLY** for overloaded ships.

## The Weather Distribution

- The choice of the Optimum Load Level (i.e. optimum level of risk) depends on
  - correct assessment of the likelihood of bad weather
  - correct assessment of the shape of the load/weather interaction.
- Financial markets overestimate the benefits of diversification (e.g. junk bonds and CDOs)
- → excessive risk taking



## Risk Transfer: the Earliest SPV?

- **Bottomry**

- Shipowner borrows to buy the cargo
- If no shipwreck, he repays loan with interest
- If shipwreck, loan is written off (non-recourse loan)
- Risk-adjusted interest rate

- **SPVs**

- SPV issues debt securities to obtain funds for home lending
- Mortgage repayments cover debt interest
- If home loan defaults, SPV defaults
- Risk adjusted interest rate

## The Impact of Insurance

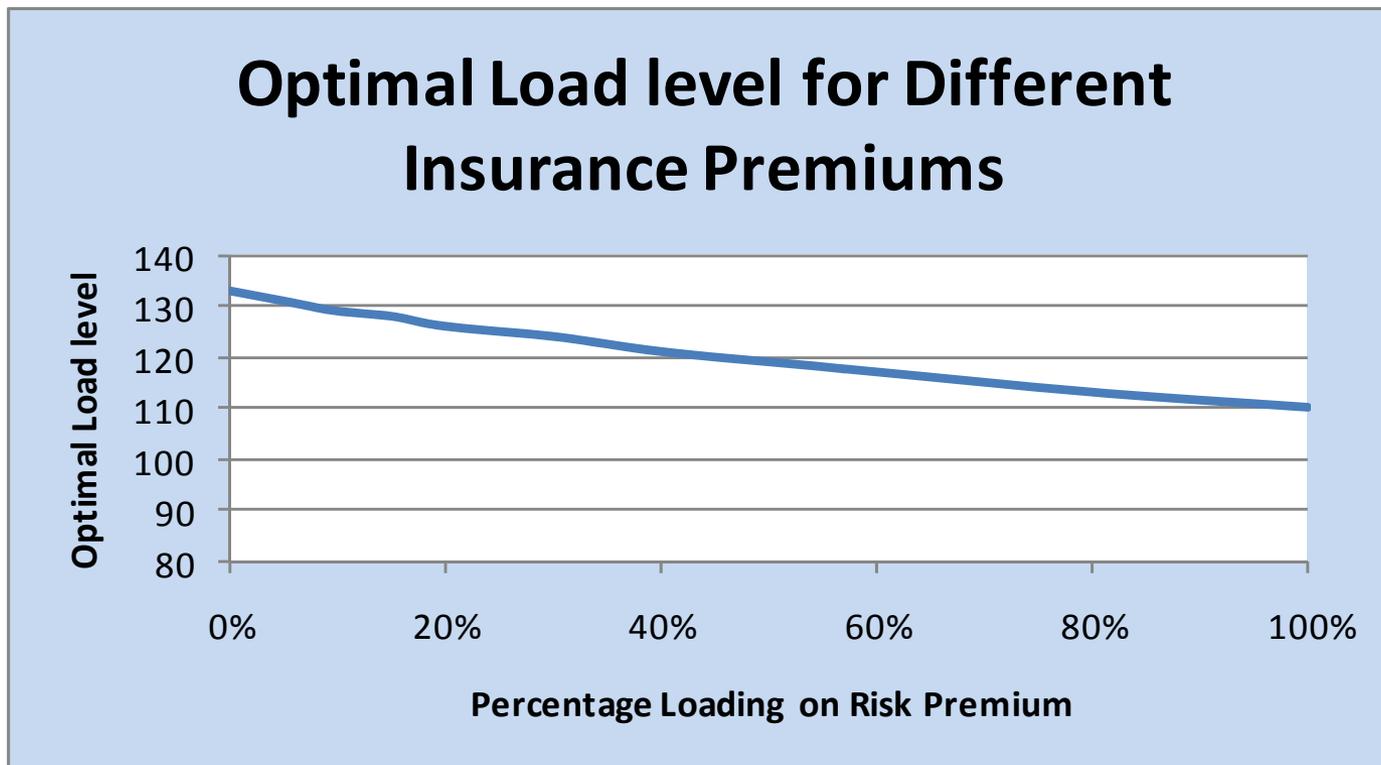
- The profit function changes
- Wealth =  $S + mL - P$  with certainty
- Result?
  - Depends on how the premium  $P$  is determined
  - In many cases, the optimum Load Level increases
  - i.e. insurance → Increasing systemic risk

## 1601 Insurance Law

- *“...by means of which policies of assurance it comethe to passé, upon the loss or perishing of any shippe there followeth not the undoing of any man, but the losse lighteth rather easily upon many that heavily upon fewe, and rather upon them that adventure not than upon them that doe adventures, whereby all merchants, speciallie the younger sort, are allured to venture more willingly and more freelie”.*

$$P = \text{Risk Premium} * (1+x)$$

- If  $P$  = the risk premium, Load = 133



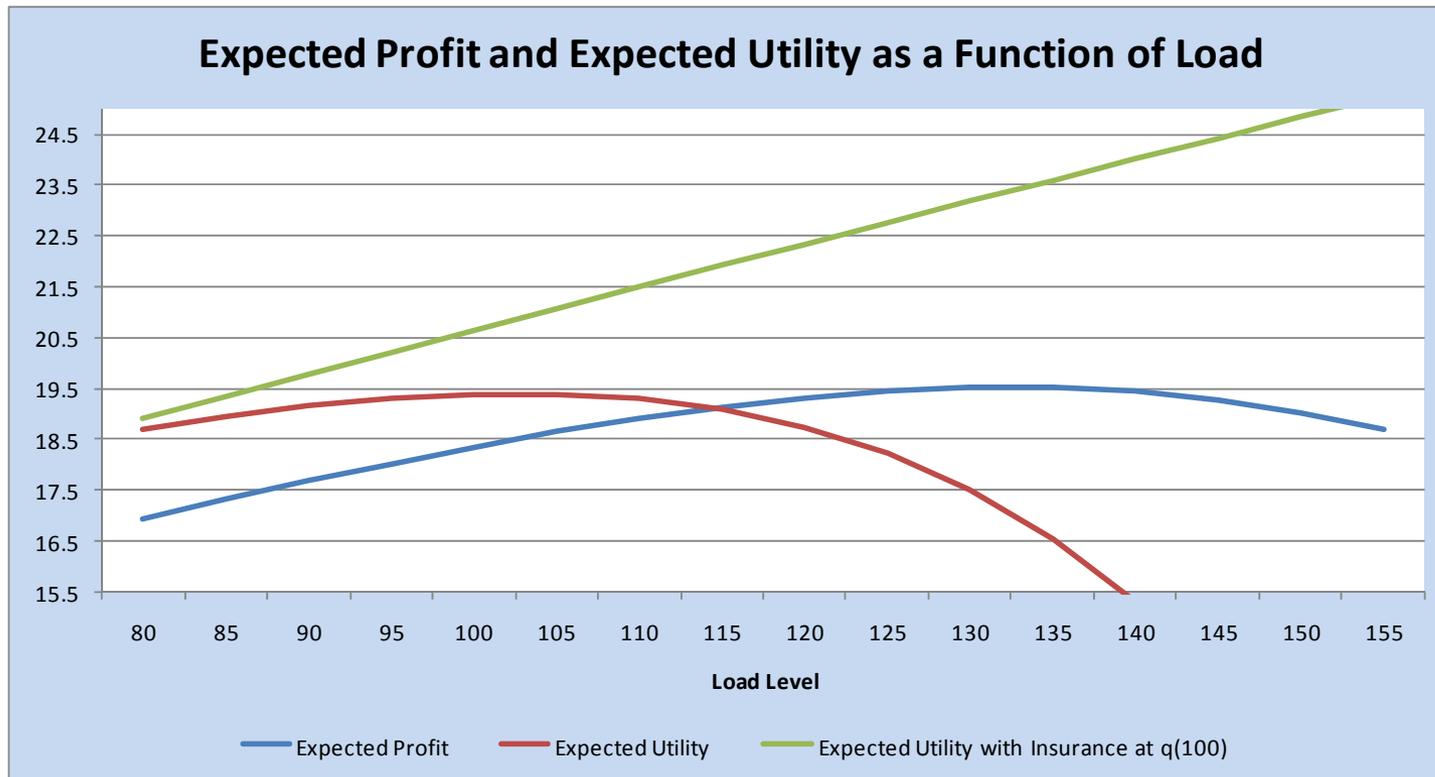
## Theoretical Exercise

- Theoretically, Premium should include a “fair value” risk margin of some sort
- Theoretical Exercise: Find out how different methods of calculating the premium would affect the optimum load level
- BUT in practice .....

## Naïve Pricing

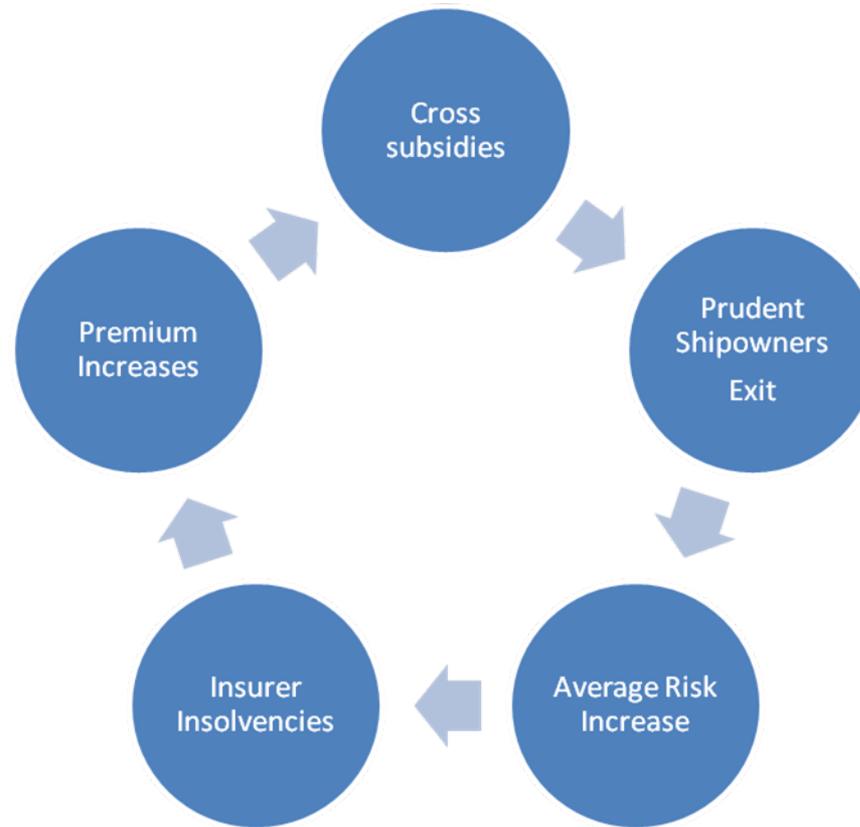
- Ineffective underwriting
- So no idea of correct risk premium for any individual ship
  - → naïve pricing, i.e. same premium rate for all
  - → insure many ships for small sums
  - → Good risks subsidise poor risks,
  - → Profitable IF premium reflects average risk
  - (Like group life insurance)
- Like Securitisation?

## The Optimum Load Level with Naïve Pricing Premium = $q(100)$

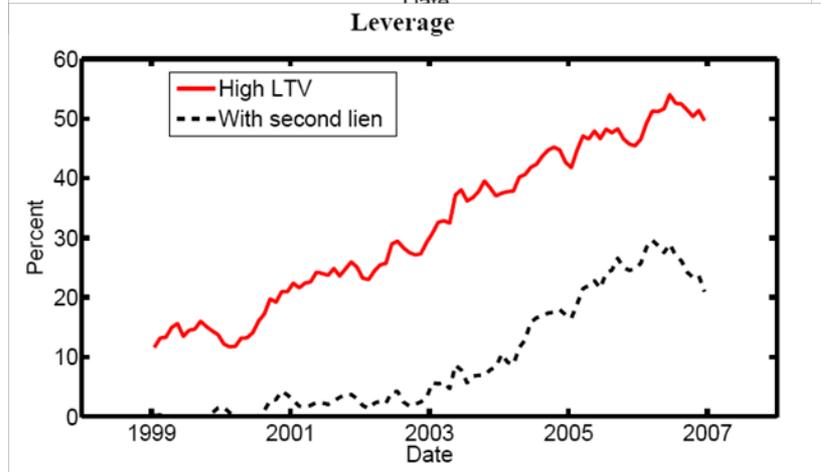
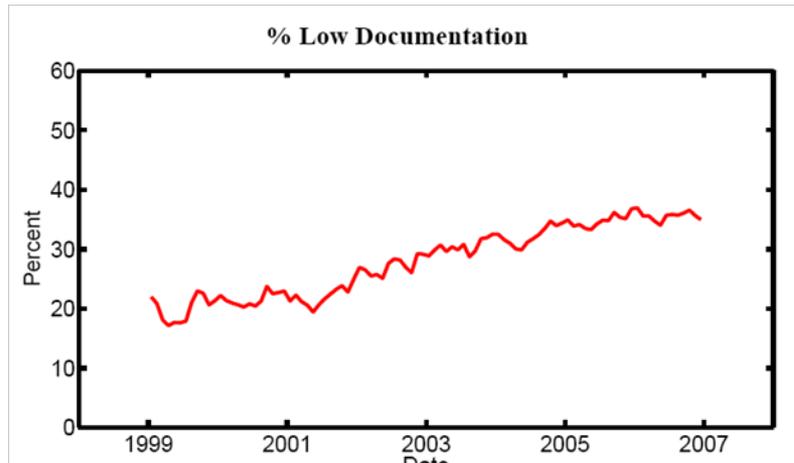




# An Adverse Selection Spiral



# Increasing Credit Risk 1999-2007



## Adverse Selection Spiral 1867

- *It is known that ships are sent to sea from our ports in an unseaworthy condition, and the effect of the enormous increase in casualties in the rates of insurance would hardly be credited by those unacquainted with the premiums of twenty or thirty years ago.”*
- *The rates are now, in many cases, double what they were formerly; and whilst, at the low premiums of a quarter of a century ago, underwriters realised fortunes, the business is now most unprofitable, in spite of the high rates of the present day.”*

## Speculation

- An inefficient insurance market
    - i.e. Mispricing of risk
  - Speculation in insurance becomes profitable
  - ESPECIALLY for those with better information than those selling insurance (i.e. “insiders”)
  - 1860s - an increase in “wager policies” at Lloyds (no insurable interest)
- 
- Speculation in the credit markets
  - Goldman Sachs ? SEC case



## Problems in Underwriting

- *Q. Why were the insurance markets so inefficient in underwriting the risks?*



# 1. Information Asymmetry

- **Ship-owners**
- Control the ship construction process
- “Devils”
- Impossible to detect from external examination

- **Home lenders**
- Control the loan approval process
- Weaknesses are not apparent to those who merely inspect the paperwork
- ? Property valuation

## SEC: Countrywide's Disclosure Fraud

- *failed to disclose increasingly lax underwriting guidelines in originating loans*
- *expanded the definition of “prime” loans*
- *A high percentage (62%) of Countrywide loans had LVRs of 100%*
- *A high percentage of loans were made outside its own already widened underwriting guidelines due to loans made as exceptions to the guidelines.*
- Q. What chance did investors have?



## 2. Diversification

- Each insurer only underwrote a small amount on any ship
- Expensive to inspect ships
- Therefore, on a cost-benefit basis, don't bother
  - *‘The amount of the total risk to which he subscribes is comparatively small and usually limited to an amount which will not make it worth his while to pursue a detailed examination.’*

## John Talbot

- *“I think that this is the mistake that these very large institutional investors made with regard to mortgages and other assets and with regard to the pricing of risk. They assumed that by being properly diversified they would minimise their risk, but their diversification strategy itself required that they hold so many assets that they did not have time to evaluate risk and return for each.*
- *Rather, [assuming that the market was efficient] they allowed the market to properly price the assets for them. In such a passive, highly diversified world, in which few are doing fundamental analysis, it almost ensures that the market itself will become corrupted.”*

## 3. Collective Risk Assessment

- Underwriters depended on collective risk assessment (like credit rating agencies)
- Lloyd's Register inspected & classified ships
  - Revenue base: fees from ship-owners
  - Ship-owners complained: too strict
  - Competition from other Registers undermined classification standards

## Competition in Risk Classification

- *“The strictness found necessary in surveying iron vessels for Lloyd's Register soon begat opposition on the part of certain builders and owners, and in 1862 the Liverpool Underwriters' Association established a "Red Book," in which great latitude was given to the surveyors. {They gave favourable ratings to ships built under their own inspection}*
- *The object of these discriminations was to compel all iron shipping to be built under inspection, — for revenue only, it appeared, for the more inspection the more money, and the stronger the competition to get business from Lloyds, the farther into the ground the trade of iron shipbuilding was run.*

## A Decline in Standards

- *“Twenty-year ships in numbers were sent to sea, and never heard from afterward.*
- *Lloyds attenuated to compete with the Red Book, reduced their requirements for strength, and the opposition followed suit, until the consequences of this deteriorating rivalry attracted the attention of the world.....”*

## SEC Report on Credit Rating Agencies

- *“... after noting a change in a competitor’s ratings methodology, an employee stated: [w]e are meeting with your group this week to discuss adjusting criteria for rating CDOs of real estate assets this week because of the ongoing threat of losing deal.*
- *In another email, following a discussion of a competitor’s market share, an employee of the same firm states that aspects of the firm’s ratings methodology would have to be revisited to recapture market share from the competing rating agency.”*



## 4. An influx of Naïve Capital

- US Civil War (1860-64)
  - High Profitability in UK
  - An influx of new insurers
  - Fighting for market share...
  - Inexperienced at underwriting
  - Premium cutting for all
  - All out of business within 5 years
- Rapid growth in the sub-prime debt market -
    - “By 2006, securitisation was funding most of the mortgage loans in the lower rated categories, the loans that are in trouble now.”
  - Worst risks were sold to the least sophisticated investors
  - Large losses (at best)



## Impact of rate-cutting

- **Note** : Our model predicts that rate-cutting on bad risks will provide an incentive for the insured to take on more risk (higher load).
  - > the underwriting cycle creates an increases in systemic risk

## 5. Enforceability issues

- The solution to asymmetric information
  - Insurance markets: “utmost good faith”
  - Debt markets : “disclosure”
- BUT: in practice,
- *Can these requirements be enforced?*

## Legal Redress

- Plimsoll said: No
  - Too expensive to go to court
  - Chances of winning are ???
  - The proof is at the bottom of the sea
  - Witnesses reluctant to testify (would never get another job).
- Q. Many investors are now suing those who sold them CDOs etc, claiming misrepresentation.
  - *Chances of success?*



**Any Solutions ?**

## 1. Safety Standards

- Plimsoll's main goal was to save the lives of sailors
  - Proposed laws to set standards of ship-building, crew sizes, and loading
  - "The Plimsoll line"
- If goal is to protect the home borrowers ...
  - Set minimum home lending standards (no predatory lending)
  - Proposed by the OCC in the USA and FSA in the UK



## Proposed Minimum Lending Standards

- No more low-doc loans;
- No more negative amortizations loans;
- No more inflated property values;
- No more excessive LTVs.
- etc.
- No one would be allowed **to sell or transfer a mortgage** without providing a warranty that such standards had been satisfied.



## **Solution 2: Better Collective Risk Classification**

- Business model based on fees
- Competition between rating agencies created a decline in standards
- Proposal : Government funding for Lloyd's Register? (levy on shipping)
- Govt politely declined

# Eliminating Competition

- Lloyd's Register
  - Took over all UK competitors (local monopoly)
  - Publicly available detailed classification standards (reduces temptation to quietly slide)
  - International agreements on standards
  - Non-compete agreements with overseas registers
  - Non profit, jointly controlled by underwriters & ship-owners

## Solution 3. Skin in the Game

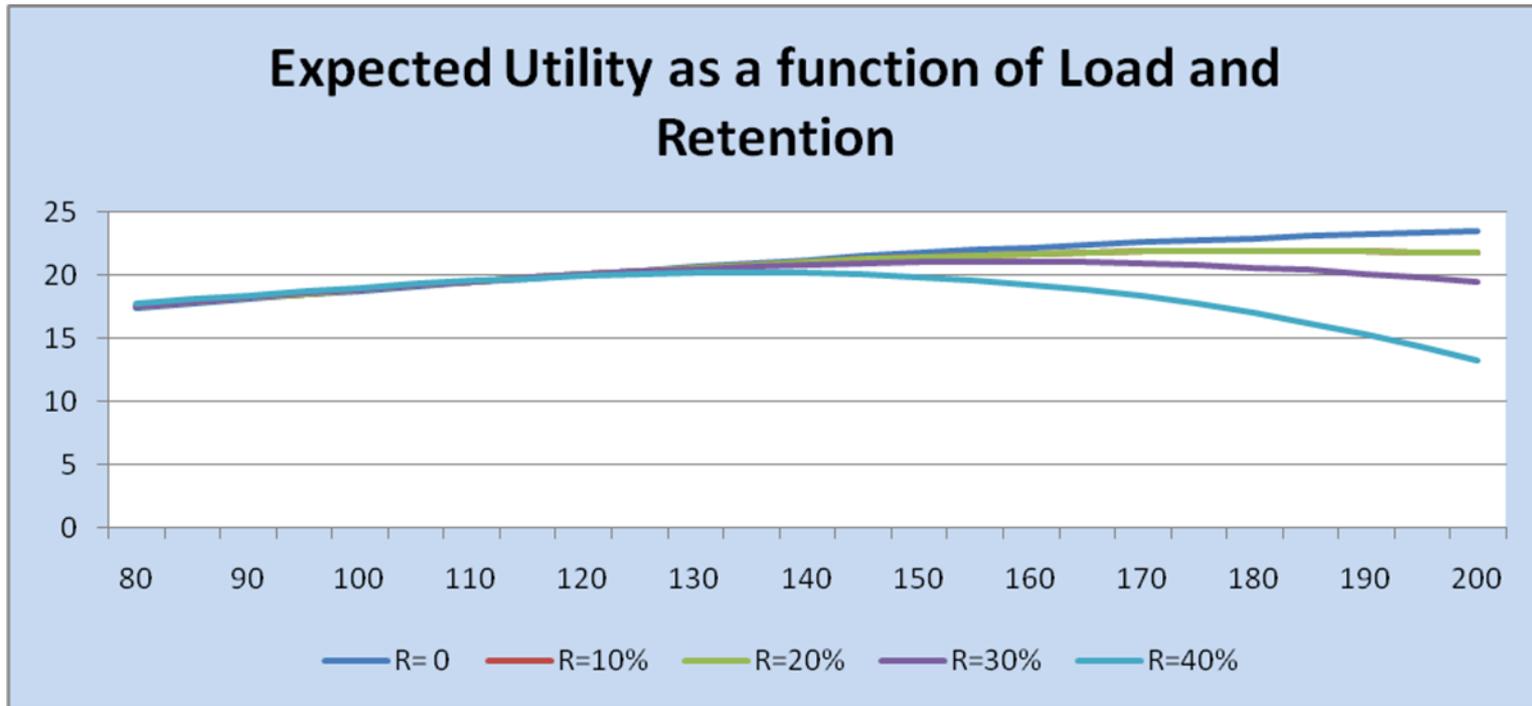
- Plimsoll: No one should be able to insure more than 2/3rds of the value of a ship
  - Remove financial incentives to overload
- The Wall Street Reform and Consumer Protection Act
  - Every company which sells mortgage backed securities would have to keep 5% of the risk
  - Soros: 5% is not enough...try 10%

## Would “skin in the game” work?

- Is 5% enough ? Or 10% ?
- What effect would it have on risk-taking?
- Can our model answer these questions?
  - Risk function  $q(\text{Load}, \text{Weather})$
  - Weather distribution
  - Profit as a function of Load
  - Risk Aversion
  - Insurance Premium Structure



Retention	R = 0%	R = 10%	R = 20%	R = 30%
Optimum Load	>200	180	155	145





## Equilibrium

- Assuming that the market reacts to any skin in the game requirements...
  - The model can be used to predict the equilibrium levels of risk taking (Load) and insurance premium rates.

## Plimsoll & Politics

- *“Although they are many, and those who profit by these practices are few, there is this difference on the part of the latter – it is their business to resist change; they profit by things as they are; they are determined, energetic, and sleeplessly vigilant.*
- *You must remember that large fortunes are being made by them; they are the most energetic and pushing men in the trade; and it would not be a matter of surprise if three of them had even got into Parliament.”*
- It took 20 years to pass the Plimsoll load-line requirements.
- And for the next 30 years after it passed, ship-owners sought to water down the rules and increase the load limits.



## Conclusion

- The main thing we learn from history is that no one learns anything from history.