



# Eurobanking - Utrecht 2010

## Customer deposits liquidity modelling

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# ALM Modelling & Global Financial Crisis

## Asset & Liability Management (ALM) SINCE AUGUST 2007

From **Interest Rate Risk Management...**  
... to **Liquidity Risk Management** (Funding Liquidity, Stress Liquidity).

## ALM MODELLING

**Behaviour Modelling...** (Assumptions Definitions – Descriptive Statistics)  
... combined with **Financial Markets Modelling...**  
... up to **models representation in ALM risk metrics** (integration in risk metrics tools)  
... with **consequences on ALM P&L and on Liquidity & IR Hedging Strategies**



# Balance Sheet example: where is liquidity risk?

(balance in M€, BNP Paribas balance sheet as of 31 Dec 2009)

## ASSETS

Cash and amounts due from central banks and post office banks	56,078
Financial assets at fair value through profit or loss	828,784
Derivatives used for hedging purposes	4,962
Available-for-sale financial assets	221,425
Loans and receivables due from credit institutions	88,920
Loans and receivables due from customers	678,766
Remeasurement adjustment on interest-rate risk hedged portfolios	2,407
Held-to-maturity financial assets	14,023
Current and deferred tax assets	12,117
Accrued income and other assets	103,361
Policyholders' surplus reserve	-
Investments in associates	4,761
Investment property	11,872
Property, plant and equipment	17,068
Intangible assets	2,199
Goodwill	10,979
<b>TOTAL ASSETS</b>	<b>2,057,698</b>

**Liquidity risk on  
Market Value**

**Cash dependant  
Funding needs**

**Drawdown risk  
of off-balance  
sheet credit lines**

## LIABILITIES

Due to central banks and post office banks	5,510
Financial liabilities at fair value through profit or loss	709,337
Derivatives used for hedging purposes	8,108
Due to credit institutions	220,696
Due to customers	604,903
Debt securities	211,029
Remeasurement adjustment on interest-rate risk hedged portfolios	356
Current and deferred tax liabilities	4,762
Accrued expenses and other liabilities	72,425
Technical reserves of insurance companies	101,555
Provisions for contingencies and charges	10,464
Subordinated debt	28,209
<b>TOTAL LIABILITIES</b>	<b>1,977,354</b>
<b>CONSOLIDATED EQUITY</b>	
Share capital and additional paid-in capital	25,061
Retained earnings	37,433
Net income for the period attributable to shareholders	5,832
<b>Total capital, retained earnings and net income for the period attributable to shareholders</b>	<b>68,326</b>
Unrealised or deferred gains and losses attributable to shareholders	1,175
<b>Shareholders' equity</b>	<b>69,501</b>
Retained earnings and net income for the period attributable to minority interests	11,060
Change in fair value of assets and liabilities recognised directly in equity	(217)
<b>Total minority interests</b>	<b>10,843</b>
<b>TOTAL CONSOLIDATED EQUITY</b>	<b>80,344</b>
<b>TOTAL LIABILITIES AND EQUITY</b>	<b>2,057,698</b>

**Deposit  
depletion risk**

## FINANCING COMMITMENTS AND GUARANTEE COMMITMENTS

### Financing commitments given:

- to credit institutions	34,882
- to customers:	238,882
Confirmed letters of credit	211,563
Other commitments given to customers	27,319
<b>TOTAL FINANCING COMMITMENTS GIVEN</b>	<b>273,764</b>

### Financing commitments received:

- from credit institutions	79,471
- from customers	6,584
<b>TOTAL FINANCING COMMITMENTS RECEIVED</b>	<b>86,055</b>



# ALM Models challenges for Liquidity Risk Management

Balance sheet by maturity ⇒ **Mismatch Maturity risk**

In millions of euros, at 31 December 2009	Not determined	Overnight or demand	Up to 1 month (excl. overnight)	1 to 3 months	3 months to 1 year	1 to 5 years	More than 5 years	TOTAL
Cash and amounts due from central banks and post office banks		56 076						56 076
Financial assets at fair value through profit or loss	828 784							828 784
Derivatives used for hedging purposes	4 952							4 952
Available-for-sale financial assets	19 709		8 139	14 853	33 831	58 063	86 830	221 425
Loans and receivables due from credit institutions	-	35 049	25 354	10 573	7 534	6 154	4 256	88 920
Loans and receivables due from customers	16	51 624	68 682	61 451	77 398	175 381	244 214	678 766
Remeasurement adjustment on interest-rate risk hedged portfolios	2 407							2 407
Held-to-maturity financial assets			-	409	130	4 421	9 063	14 023
<b>Financial assets by maturity</b>	<b>855 888</b>	<b>142 749</b>	<b>102 175</b>	<b>87 288</b>	<b>118 893</b>	<b>244 019</b>	<b>344 363</b>	<b>1 895 353</b>
Due to central banks and post office banks		5 510						5 510
Financial liabilities at fair value through profit or loss	655 330		615	3 935	8 348	27 264	13 845	709 337
Derivatives used for hedging purposes	8 108							8 108
Due to credit institutions		20 372	102 613	23 303	47 281	16 624	10 503	220 696
Due to customers		334 942	175 397	40 147	22 109	13 936	18 372	604 903
Debt securities			61 556	55 989	36 582	49 929	6 973	211 029
Subordinated debt	3 088		29	483	1 058	5 915	17 636	28 209
Remeasurement adjustment on interest-rate risk hedged portfolios	356							356
<b>Financial liabilities by maturity</b>	<b>668 882</b>	<b>360 824</b>	<b>340 210</b>	<b>123 857</b>	<b>115 378</b>	<b>113 668</b>	<b>87 329</b>	<b>1 788 148</b>

Implication of ALM Models teams in:

- Demand deposits modelling **STABILITY OF CUSTOMER DEPOSITS?**
- Capital Markets liquidity position modelling **STABILITY OF TRADING BOOK LIQUIDITY POSITION?**
- Off-Balance sheet modelling **RISK OF DRAWDOWNS ?**
- Prepayment modelling **NEW PRODUCTION / EARLY PAYMENT ?**



# Deposits liquidity modelling

WHAT IS THE STABILITY OF CUSTOMER DEPOSITS?

HOW MUCH CAN THE BANK INVEST IN LONG TERM ILLIQUID ASSETS (in front of these customer deposits)?

**Modelling depends upon organisation & customer types**

- Wholesale banking (treasury funding, interbank funding, fiduciary funding...)
- Wealth Management for private customers
- Retail Banking & CIB
- Individual
- Private customer
- Small business
- Medium and Large corporate
- Public funds
- Financial Institutions

**TWO KINDS OF MODELS FOR TWO DIFFERENT NEEDS**

■ **« BUSINESS AS USUAL » MODELLING**

Developing models in order to predict the DEPOSITS AMOUNT PROJECTION linked with the EXISTING CUSTOMERS

■ **STRESS ENVIRONMENT MODELLING**

Developing models in order to know what is the customer behaviour in STRESS CONDITIONS



# **FOCUS ON “BUSINESS AS USUAL” DEPOSIT MODELLING**



# Business as usual hypotheses (1)

Measuring liquidity exposures only looking at demand deposits linked with existing customers = Making implicit hypotheses on new production

**The measurement of the probability to end the relationship with the customer is the key of deposit liquidity modelling (in business as usual situations)**

For each business, Liquidity risk Modelling has to be in line with the various hypotheses:

- **Hypotheses of continuation of a global relationship with the customers**
- **Is there a symmetric or automatic link between one side of the balance sheet & the other?**
  - **No obligation to lend to the customer to conserve the deposits?**
- **Link between customer deposit stability and business model**
- **The relationship can be also a function of the number a products the bank has sold to the customer.**



## Business as usual hypotheses (2)

Consequently, models have to take into account the **customer segmentation**:

- Links with other products sold to customers
  - E.g. links between Deposits and Assets Under Management (AUM) for private customers
  - E.g. Online Banking offer : deposit remunerated with a bonus rate if simultaneously deposit securities for at least 3 k€.
- Customer type
  - Deposit oriented (security of savings)
  - Investment / tax exemption oriented
  - Inheritance oriented
- Customer global relationship
  - E.g. Differentiation between WMI and WMN customers

**Other structural effects have to be taken into account such as generation effects.**

- ⇒ **Need to know the business (KYC and KYB)**
- ⇒ **It is then necessary to build UNITARY DATABASES to follow precisely the customer behaviour.**



# Customer Behaviour & « Business as Usual »

**BUSINESS AS USUAL : Quantification of the evolution of the number and of the amount of demand deposits linked with currently existing customers**

The amount projection model based on the modelling of the customer behaviour includes :

- **Demand deposit closing probability modelling** (by customer segment) or **global relationship extinction modelling** (if the link with the customer is not the demand deposit)
- « **Life cycle effect** » **modelling** (average amount by account growth as a function of account age)
- Transition effects modelling (transition between segments)
- Volume effects modelling (« arbitrages » between liquid savings)
- Wealth effect modelling (average amount by account growth as a function of time)



# Example of Business as Usual model

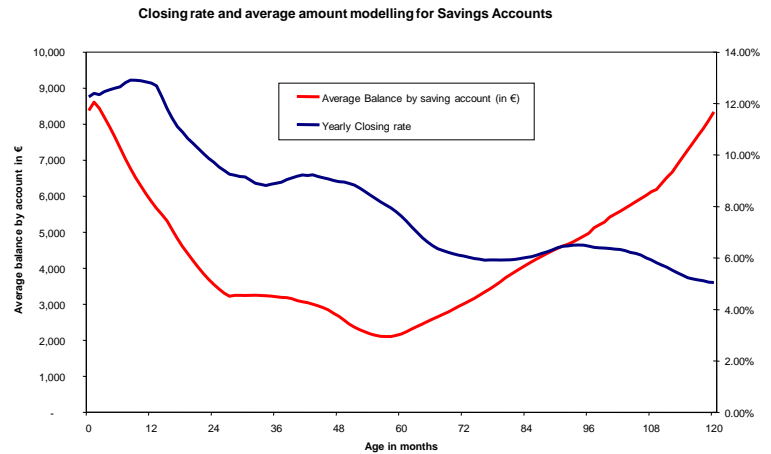
From databases ...

Number of accounts	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09	Jan-10	Feb-10
Aug-09	2,477	2,454	2,442	2,429	2,424	2,414	2,410
Sep-09	x	2,740	2,720	2,713	2,706	2,696	2,694
Oct-09	x	x	1,930	1,916	1,906	1,898	1,892
Nov-09	x	x	x	1,895	1,886	1,877	1,873
Dec-09	x	x	x	x	2,164	2,154	2,151
Jan-10	x	x	x	x	x	3,391	3,371
Feb-10	x	x	x	x	x	x	2,110

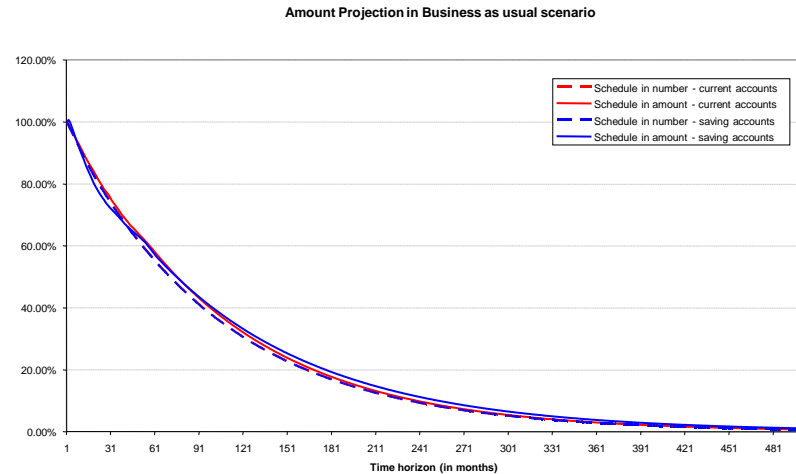
  

Savings amounts	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09	Jan-10	Feb-10
Aug-09	18,448,313	41,412,474	44,452,282	44,708,984	43,535,092	45,058,117	44,971,635
Sep-09	x	20,478,811	41,192,267	44,050,106	43,742,183	46,054,616	46,452,247
Oct-09	x	x	19,422,241	29,174,566	31,689,695	34,545,323	34,367,521
Nov-09	x	x	x	15,463,171	34,647,039	38,468,030	39,841,680
Dec-09	x	x	x	x	39,407,798	60,309,742	63,694,985
Jan-10	x	x	x	x	x	27,663,321	51,159,961
Feb-10	x	x	x	x	x	x	11,872,454

...to model estimation...



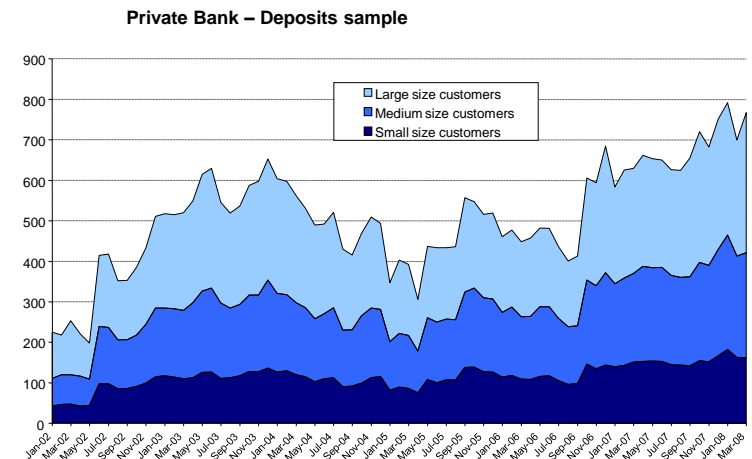
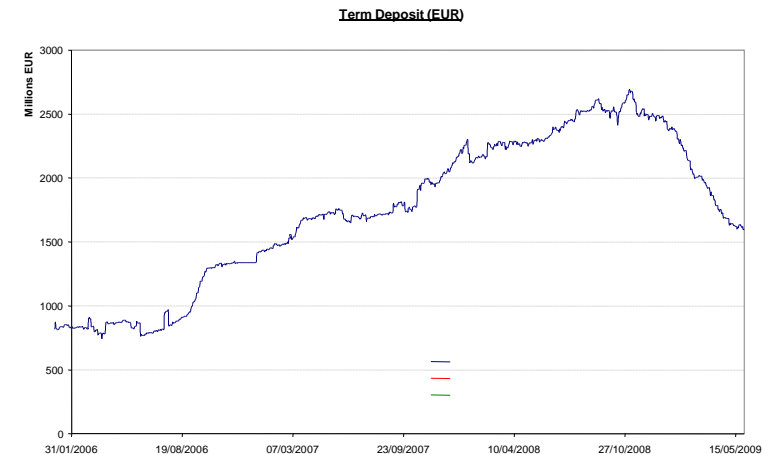
...to amount projection



# “Business as usual” taking into account uncertainty

**Modelling includes many sources of uncertainty.** The uncertainty and the exogenous risk sources are taken into account in the liquidity schedule: a confidence interval allows us to be sure that the amounts projected in the liquidity schedule will be effectively present in the balance sheet at the horizon (within the confidence interval).

- Modelling the **total amounts volatility**
- Modelling the **intra-monthly volatility**
- Modelling the **granularity of the portfolio** and the **diversification between portfolios**
  - Exclusion of the too large customers at local level (e.g. Private Banking)
  - Diversification at consolidated level



## Granularity & diversification

Geographic zone is a key element to take into account in the local management of liquidity risk. In particular for those granluarity effects.

At the bank consolidated level, granularity effects are diversified and there are potential compensation between local geographic portfolios when liquidity can cross the frontiers.

Local site number	1	2	3	...	50	Bank
Deposit amount	96	106	109	...	115	5,085
Deposit amount quantile	72	86	87	...	91	4,911
Granularity effect	<b>25%</b>	<b>19%</b>	<b>21%</b>	...	<b>21%</b>	
Granularity / diversification effect						<b>3.4%</b>



# **FOCUS ON DEPOSIT MODELLING IN A “STRESS ENVIRONMENT”**



# Customer Behaviour in **Stress** environment

**Deposits include a liquidity option sell:** if the bank is downgraded (either by a rating agency or implicitly considered as downgraded by the markets) or more generally **in specific liquidity stress situations the customer has the option to leave the bank and withdraw all deposits at any time.**

Liquidity Stress covers many notions:

- **Systemic Stress:** the whole marketplace is short of liquidity
- **Specific Stress:** bank's name is attacked and the bank specifically is short of liquidity
- **Mixed Stress:** Mix between systemic and specific stress

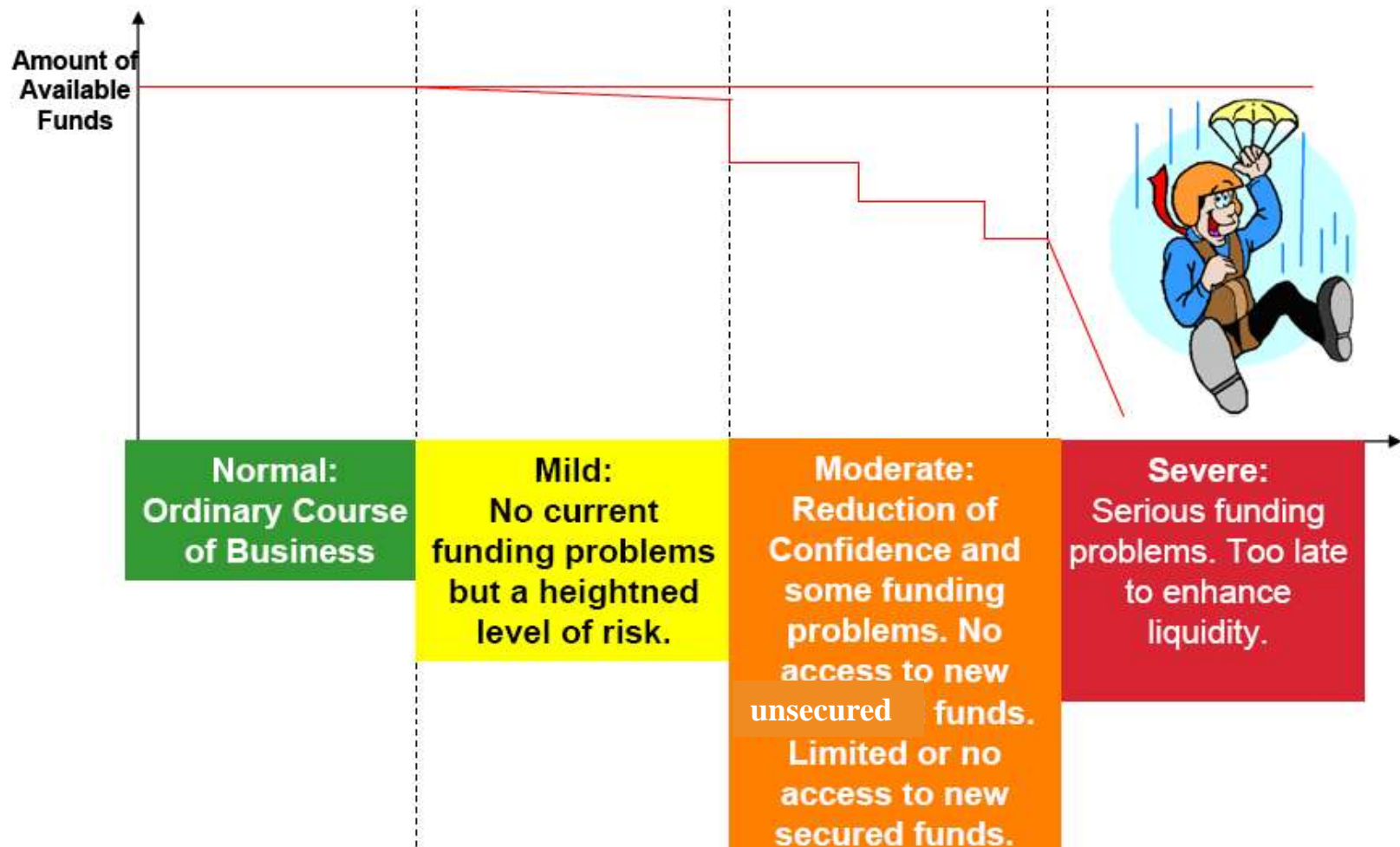
Modelling customer behaviour in stress situations covers many fields:

- **Customer probability of account closing in stress situations**
- Remuneration modelling (correlation between deposit customer rates and bank liquidity situation)
- Volume effect modelling (correlation between amounts and bank liquidity situation)
- Fly-to-quality modelling

All these models take into account the **potential delays** between liquidity stress information and customer behaviour reaction.



# Stress Testing: **Stress** Levels - Problems Unfold Over Time



## Liquidity Stress Scenario: some examples...

FINANCIAL INSTITUTION	TRIGGER
Barings Bank, 1995	Inadequate internal controls, improper trading, margin calls
Daiwa Bank, 1995	Inadequate internal controls, trading losses
Yamaichi 1997	Disclosure of fraud cover-up concurrent systemic crisis in Japan
LTCM, 1998	Correlation risk arbitrage positions, margin/collateral calls and leverage
Commerzbank, 2002	Market rumors
Abacus Federal Savings Bank, 2003	Embezzlement leading to a loss of confidence by depositors.
Countrywide, 2007	Subprime and other poorly underwritten mortgage loans
Northern Rock 2007	No backup plan for a strategy that depended on loan securitizations to retire short-term borrowings.
UBS, 2007	Investments in securitized U.S. mortgages.
Bear Stearns, Merrill Lynch and Lehman Brothers, 2008	Losses from mortgage backed securities and CDOs. Excessive leverage. Management hubris.
Fortis, 2008	Investments in securitized U.S. mortgages.
Washington Mutual, 2008	Bad loans, lack of risk management culture, management hubris.
Wachovia 2008	Losses from option ARMs, overpaid for acquisition of a California financial institution.
Indy Mac, 2008	Bad loans, management hubris, Schumer Risk.
CitiBank, 2008	Bad loans, lack of risk management culture, management hubris
Bank of America, 2008	Bad loans, over paid for acquisition of Countrywide



# Fortis Bank Stress Scenario: What Happened?

## Confidence breakers:

Mild Stress Level

- 21/09/2007: Fortis launches a 13.4 B€ share capital increase offer to finance overpaid ABN AMRO assets.
- 07/03/2008: Fortis announces less than expected annual profit and passes 1.5 B€ as provisions for CDO losses.

Moderate Stress Level

- 26/06/2008: Fortis Bank accelerated its solvency plan and blocked the payment of interim dividend contradicting repeated recent financial strength affirmations.
- 27/06/2008: Downgrade by Moody's the Long term debt note from AA2 to AA3.
- 10/07/2008: Management reshuffle
- 17/07/2008: Downgrade by S&P from AA+/Watch Negative to A+/ Stable
- 11/08/2008: Downgrade of Scaldis conduit from A1+ to A1
  - Increase of borrowing cost (+25 bps) and narrowing investors base.

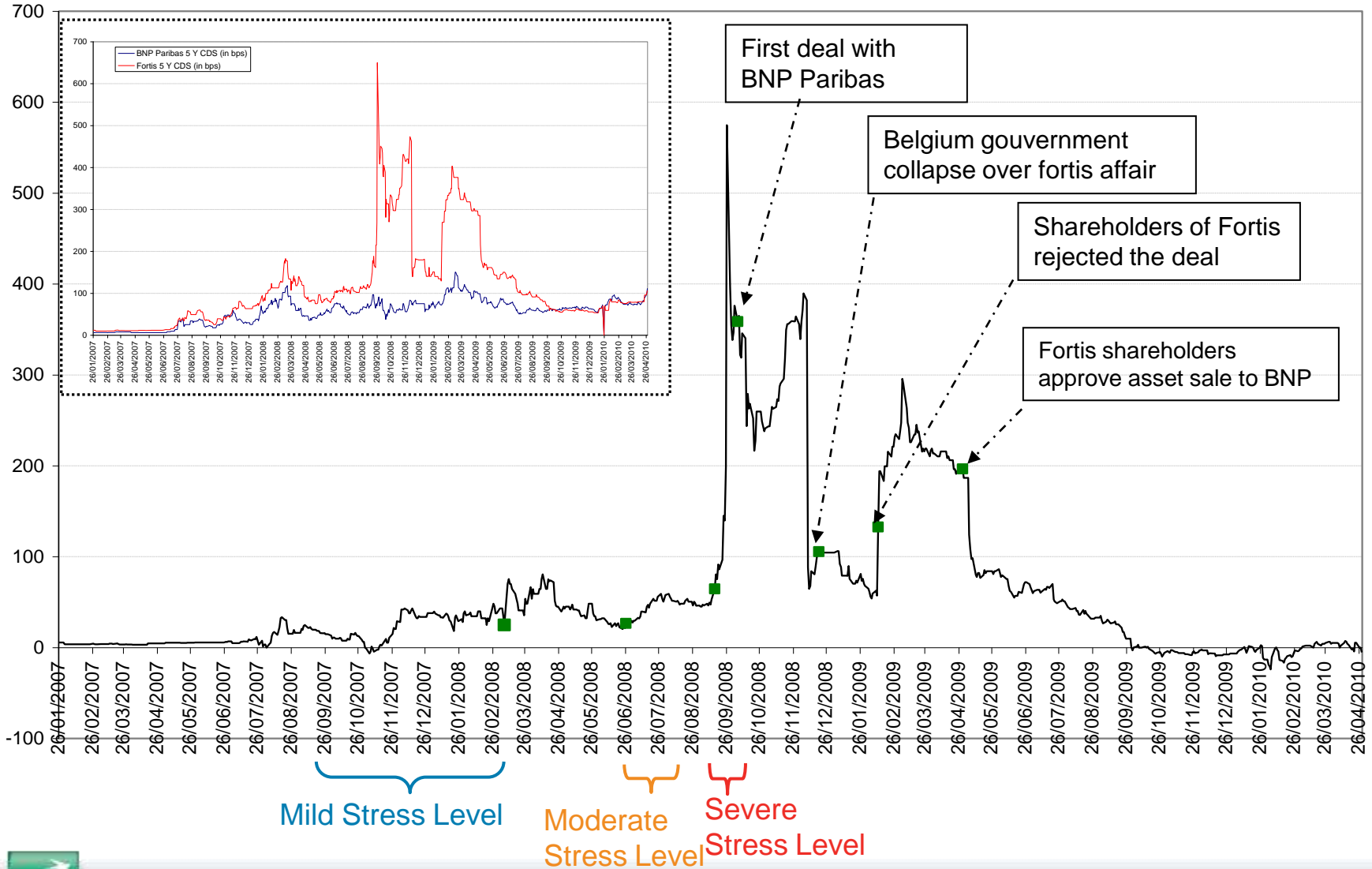
Severe Stress Level

- 15/09/2008: Lehman Brothers bankruptcy filing and market wide funding markets turmoil.
- 29/09/2008: Actions by rating agencies after governments bailout:
  - Fitch: downgrade from AA- to A+,
  - Moody's: downgrade from AA3 to A1,
  - S&P: downgrade from A+/A-1 to A/A-1
- 06/10/2008: First deal for the sale to BNP Paribas
  - Fitch: downgrade Individual Rating from "D" to "F", indicating that FB would have defaulted without external support



# Fortis & BNP Paribas 5 years CDS

Spread of (Fortis CDS 5Y - BNPP CDS 5Y CDS)



# September 2008 Stress Scenario: Market Turmoil

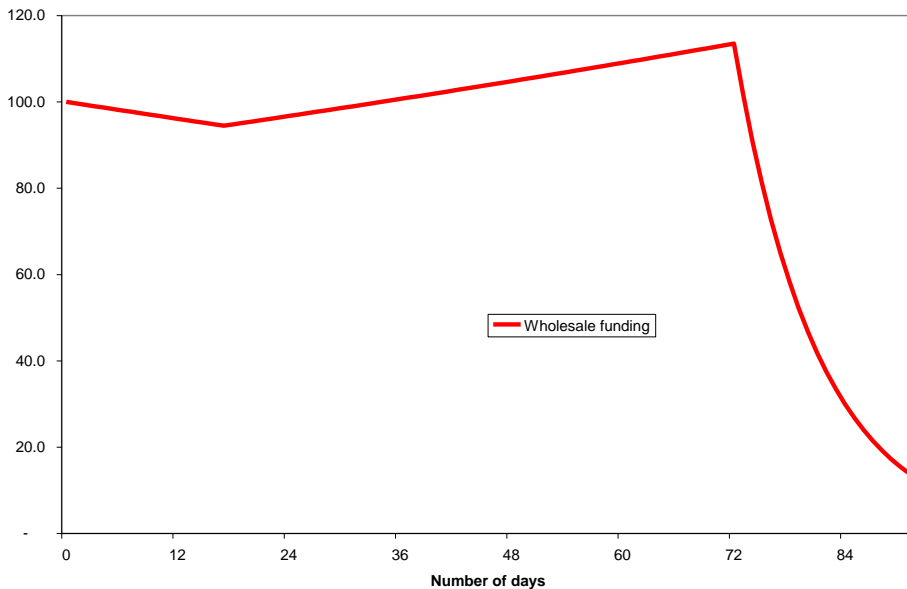
- The financial crisis has been characterized by a dramatic lack of confidence in banks solvency and capacity to repay debt. The crisis peaked each quarter since July 2007 but reached its **top in September 2008 after the bankruptcy of Lehman Brothers.**
- The market turmoil had its consequences on the existent funding channels for banks. **Long term debt markets** are to a great extent **closed** in 2007/2009.
- Due to the confidence crisis among banks, lending and borrowing **tenors dropped to overnight or spot-next level.**
- The **refinancing capability of structured asset portfolios** became almost **inexistent.** The liquidity value of the banks structured portfolio dropped dramatically.
- Institutional investors recalled massively the collateral ("**run on collateral**") that was lent to financial counterparts.
- Banks deposited large amounts of cash on **central bank deposit accounts : run on banks by banks.**



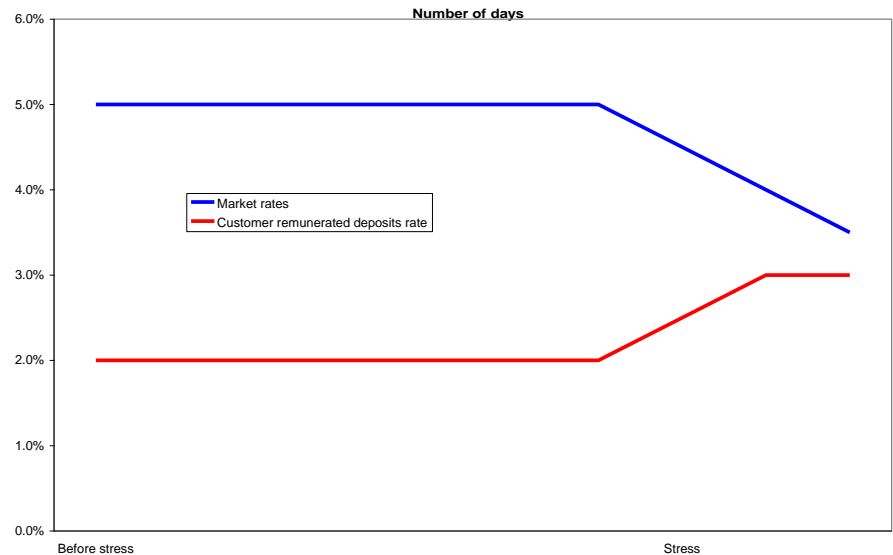
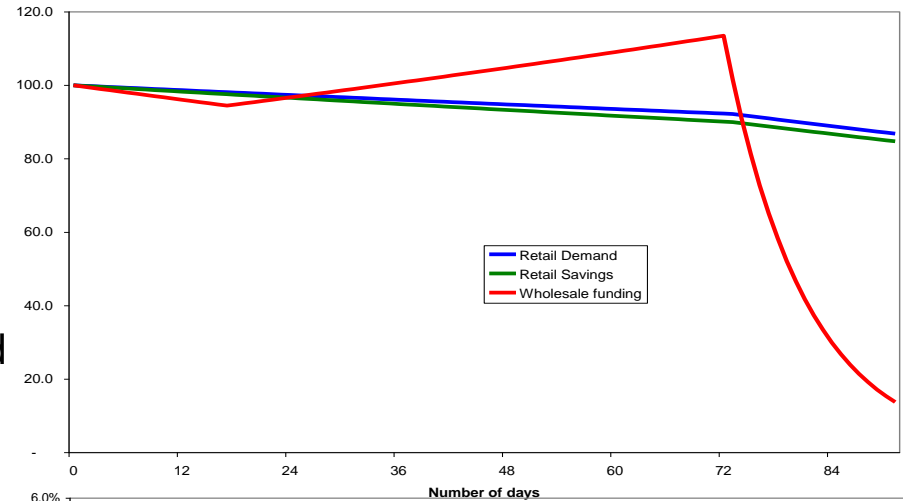
# Model have to take into account behavior in stress scenario

- Customer probability of account closing in stress situations:
  - ⇒ Large and instantaneous impact on wholesale funding
  - ⇒ Deposit customer rate increase in case of stress
  - ⇒ The initial increase is due to volume effect and the excess of remuneration at 1<sup>st</sup> stage

Deposit depletion in stress situations



Deposit depletion in stress situations



# Delays / Reactivity

Ranking by volatility:

*Indicator : Maximum daily loss in percentage*

<b>Deposits product</b>	<b>The maximum daily loss</b>
<b>Most volatile wholesale customers</b>	24%
<b>Private more volatile customers</b>	11%
<b>Private less volatile customers</b>	7%
<b>Retail more volatile customers</b>	6%
<b>Retail less volatile customers</b>	2%



# AS A CONCLUSION



## Modelling and ALM strategy

Deposit depletion rate in stress situation =  $X\%$

Average life of deposits in « business as usual » situation =  $Y$  years



$X\%$  of deposits have to be invested in liquid assets

$(1-X\%)$  of deposits can be invested in illiquid  $Y$  years horizon assets



# Modelling conclusions

**Modelling deposits means working with local businesses.**

**Customer behaviour modelling is the first step to understand the business & its liquidity risk exposure:**

- Liquidity risk representation
- Liquidity risk management strategy

Modelling does not only mean extrapolating information from databases. This is especially true when the bank **did not experience a specific liquidity crisis.**

