TEACHING AN OLD DOG NEW TRICKS
OUR FAIR PRICE ENGINE

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DYALOG USER MEETING 2018
MY FAB TEAM AND ME

- **6 Programmers**: 4 based in Milan, 1 in Pistoia, 1 in Trieste
- 3 graduated in Mathematics, 2 in Physics, 1 Actuary
- Pair Programming
- Work Alone
- Shared Analysis
SimCorp Sofia

- Integrated System for Institutional Investors
- Position Keeping
- Risk Management
THREE PER CENT

LOAN OF 1898.

1898

1918

The United States of America

ARE INDEBTED UNTIL THE BEARER IN THE SUM OF

20 TWENTY DOLLARS

20 TWENTY DOLLARS

This bond is issued under authority of an Act of Congress entitled "An Act to provide means and means to meet war expenditures approved June thirteen hundred and ninety-eight, and is redeemable at the pleasure of the United States after the first day of August, 1908, and payable August 1, 1908 in even, with interest at the rate of three percent per annum, payable quarterly on even, on the first day of November, January, April, and August in each year. The principal and interest are exempt from all taxes or duties of the United States as well as from taxation in any form by, or under State, municipal or local authority.

Act of June 13, 1898.

Washington, D.C., August 1, 1898.

J.W. Evans
Register of the Treasury
ZERO COUPON BOND
A FIXED COUPON BOND is a type of bond that pays a fixed interest rate, known as the coupon rate, at regular intervals (usually semi-annually). The price of the bond, $P$, can be calculated using the following formula:

$$P = \sum_{i=0}^{n} \frac{c}{(1+r_i+s)t_i} + \frac{R}{(1+r_n+s)t_n}$$

where:
- $c$ is the coupon payment per period,
- $r_i$ are the interest rates per period,
- $s$ is the yield to maturity,
- $t_i$ are the time periods until each payment is made,
- $R$ is the redemption value of the bond,
- $t_n$ is the time period until the bond matures.
Floater Coupon Bond

\[ P = \sum_{i=0}^{n} \frac{f_i}{(1+r_i+s)t_i} + \frac{R}{(1+r_n+s)t_n} \]
In the beginning was the Pricing
and the Pricing was with the Engine
and the Pricing was the Engine
BOND FAIR PRICE CALCULATION

SECURITY INFORMATION

CREDIT SPREAD

TERM STRUCTURE OF INTEREST RATES

GETSpr

GETCurve

No holding information is needed, we need just the security specifications

\[ P = \sum_{i=0}^{n} \frac{f_i}{(1+r_i+s)\tau_i} + \frac{R}{(1+r_n+s)\tau_n} \]

FAIR PRICE
THE ENGINE BIRTH
STEP 1: STRESS TEST- MANAGING TWO CURVES

The 30/12/2005 Italian regulator asked the Insurance Companies to analyse the behaviour of the portfolio under market shocks as:

- Interest rates
- FX rates
- Credit Spread
- Equity Indices

STRESS TEST MODULE

It's based on a full repricing approach and it allows to define market scenarios taking into account changes in interest rates, credit spread, equity indices, fx rates.
FAIR PRICE ENGINE
No holding information is needed, we need just the security specifications.

STRESS TEST MODULE

STEP 1: STRESS TEST- MANAGING TWO CURVES

SECURITY INFORMATION

GETSpr

2 Spread:
- Mkt spread
- Stressed spread

GETCurve

2 CURVES:
- Mkt curve
- Stressed curve

STRESSED PRICE
SIDE EFFECT
BORN JUNE 2006

- Effective Duration
- Spread Duration

\[ D = \frac{P_+ - P_-}{2Ph} \]
INTEGRATE THE CALCULATION CORE WITH THE ALM MODULE

**Fair Price:**
- 1 Curve
- Credit Spread

**Stress Test: 2 Curves**
- 2 curves
- 2 spreads: implied Stressed spread

**Asset Liabilities Management:**
- Many curves: a Forward Curve for every end of month for at least 5 years
- 2 spreads: Mkt spread and user defined spread
ASSETS LIABILITIES MANAGEMENT

- Projection of portfolio future value and expected cash flows for both assets and liabilities
- Time horizon of many years → multiple forward dates

**ASSETS:**
- Interest rate risk and liquidity risk
- Credit risk rescaling scenarios
- Prices (including embedded options prices), flows, accruals, callable bonds moneyness, durations
- Future buys and sells

**LIABILITIES:**
- Clustering of policies into model points
- Projection of future deaths, surrenders, etc… and corresponding cash flows
ALM MODULE

STEP 2: MANAGING A FAMILY OF FORWARD CURVES

SECURITY INFORMATION

- Spread:
  - Implied spread
  - User Defined

GETSpr

A CURVE FAMILY
- Mkt curve
- Fwd curve

GETCurve

No holding information is needed, we need just the security specifications

- Buy and sell Fictitious Assets in the forecast.
- Rebalancing calculation mechanism: Simulation of buys and sells, calculation of new holdings values

FWD CASHFLOWS & FWD PRICES
As a result of the financial crisis of 2008, the Financial Accounting Standards Board (FASB), decided to revise their accounting standard introducing this test:

The Benchmark Test is performed on all bonds whose coupon rate is indexed to a interest rate whose frequency doesn’t match the coupon frequency. The test involves the comparison of two cashflows.
Using the engine in so many different contexts implies that it must be able to receive the input data in many different forms:

**INTEREST CURVES**
- 1 curve for FP
- 2 curves for Stress Test
- Many **fwd** curves for ALM

**CREDIT SPREAD**
- Market spread for fair price
- Implied spread or **user defined** spread elsewhere

**CREDIT RISK**
rescaling scenarios
THE FAIR PRICE ENGINE

In each context the output requested may be very different:

- Just prices, for example for VaR Stress test
- Just flows for SPPI benchmark test
- Prices (embedded options prices), flows, accruals, callable bonds moneyness, durations for ALM
THEN THE (ALMOST) IMPOSSIBLE BECAME REALITY

• On 11 June 2014 the ECB introduced the negative interest rates
• Black models stopped working
• Change model
• In fact we have two different Fair price engines: one is based on closed formulas the other is a Monte Carlo based on Hull-White model.
HWcalc

Monte Carlo based on Hull-White model

FPcalc

Closed formulas
At the end was the **engine**

- **Fair Price**
- **Stress Test**
- **Effective and Spread Duration**
- **SPPI Benchmark Test**
- **Profit and Loss Attribution**
- **ALM**
- **SCR**
- **VAR**
THANKS TO

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Ambra C – ARCL