CreVar

**the toolkit to monitor and manage
Credit Portfolio Risk**

iason

Introducing CreVar

Measuring credit exposures and unexpected losses is a crucial activity for a bank in the current economic and financial environment. The ability to identify risks, to capture them in a consistent framework and then compute a Credit VaR that correctly indicates the Economic Capital needed to support the business, is the challenge we wanted to accept.

CreVar is the solution that Iason developed, in cooperation with Avanade, to manage the credit risk and calculate the Economic and Regulatory Capital. The calculation engine is a model designed by our experts to match the following requirements:

- **Smooth connection** between the Pillar I VaR and the total VaR: ideally, the model should start from the same analytical formula derived in the Pillar I case and corrections should be added, accordingly to the regulation.
- **Consistency** of the total result: most credit VaR models produce total VaR estimates, that, in many cases, are lower than the Pillar I VaR. If on one hand, the calculation of a VaR comprehensive of all risks seems therefore redundant, on the other, this disagrees explicitly with the request of the Regulator, according to which the Pillar I result underestimates the "true" credit VaR.
- **Intuitiveness** of input data: these should be ready available in the banking system and easily identifiable.

The model

The model we designed has the following strengths:

- **Analytical** computations, with huge saving of computational time.
- **Consistency** with the regulatory model is perfectly met, since
  - o The starting point is the same as in the Pillar I case.
  - o The calibration procedure to the "benchmark" portfolio makes the single-factor formulation

of the Regulator comparable with the multi-factor setup of the model.

- **Significance** of the adjustments, whose contribution is additive with respect to the Pillar I result, unless an important diversification effect among sectors occurs in the bank portfolio

CreVar is strongly oriented to current regulation, allowing for an easy reconciliation of the Economic Capital with the Regulatory Capital.

CreVar computes the portfolio Credit VaR starting from the basic formula of Pillar I of the Basel II regulation, then extending the analysis to include Pillar II risks:

- The **granularity** adjustment is calculated through an expansion of the "true" VaR with respect to regulatory VaR, computed on the asymptotic loss distribution which satisfies the hypothesis of the Asymptotic Single Risk Factor (ASRF) model.
- The **sectoral** concentration is taken into account by introducing several systematic risk factors can lead to an imperfect diversification. We consider sectors of industry-geographic type, whose number can be freely chosen by the user.
  In addition to the inputs of the ASRF model, we need to feed the following external data:
  - o obligor/sector correlations,
  - o sector/sector correlations.

  The effect of sector risk on VaR crucially depends on the distribution of portfolio loans on sectors. In order to compare the multi-factor VaR with the Pillar I VaR (obtained for a single-factor portfolio which mimics the effect of a "well diversified" multi-factor one), it is necessary to identify a benchmark portfolio with which to compare the model VaR on the regulatory one. Debtors' factor weights are derived with a formula derived from the one indicated by the Basel II, Pillar I, framework.
- **Contagion** risk accounts for interaction effects among different obligors (of business, legal and financial type). We propose a contagion specification which takes into account the overall sensitivity of each obligor to contagion, through
  - o A general contagion factor loading.
  - o The dependence of each obligor form specific groups of contagion agents.

In order to define this more precisely, we divide obligors into two classes:

o "I-firms": obligors who are immune from contagion, but can propagate it;

o "C-firms": obligors who can be infected.

Each sector is divided into an "I" and "C" segment. The dependence of every "C" obligor on the "I" part of each sector is encoded into proper weights defined by the user.

The output is a total Credit VaR decomposed in asymptotic component correspondent to the Basel II, Pillar I formula in a multi sector environment, the granularity adjustment and finally the contagion correction.

The Application

CreVar is a light, yet robust, application that can be swiftly inserted in the Bank's risk management processes and systems.

CreVar allows to easily specify the model and the inputs, according to the needs of the Bank. More specifically, the user can set without any constraint:

- Number of macroeconomic factors.
- Number of sectors: they can be defined according to economic and/or territorial criteria.
- Number of correlation buckets between obligors and sectors.
- Number of rating classes: each of them will be characterized by a PD and an LGD.
- Obligors assignment to one or more sectors.
- Obligors assignment to the "I" class or the "C" class.
- Definition of the weights through which infected obligors can depend on one or more infecting segments.
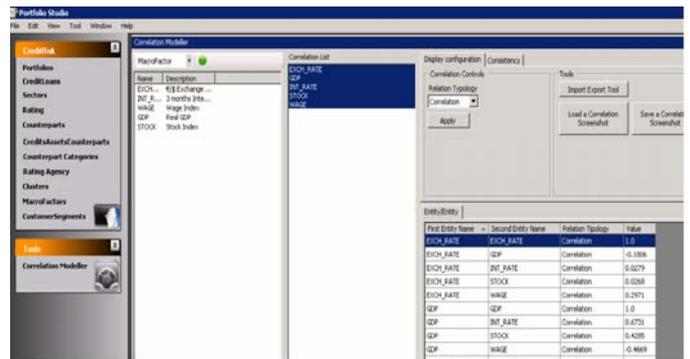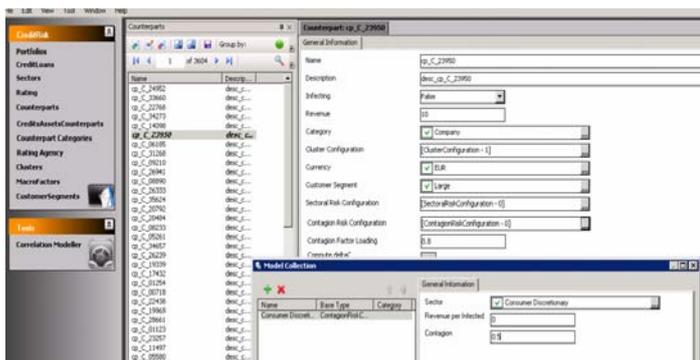
The output report clearly identifies:

- The total Credit VaR
- Pillar I ASFR VaR
- Pillar I, multi-factor VaR
- Pillar II (concentration) contribution to total VaR, with the separate contributions of the
  o Granularity adjustment.
  o Sectoral adjustment.
  o Contagion adjustment

An example of the output is below

Credit Risk Simulation		
Corporate Portfolio (% values)		
Total Credit VaR	Pillar I Single Factor	Pillar I Multi Factor
100	55,64	99,256
Concentration Risk	Economic Capital	
44,36	82,933	
Contagion Risk	Granularity Adjustment	Sectorial Adjustment
0,154	0,222	44,135

- Pillar I
- Granularity Adj.
- Sectorial Adj.
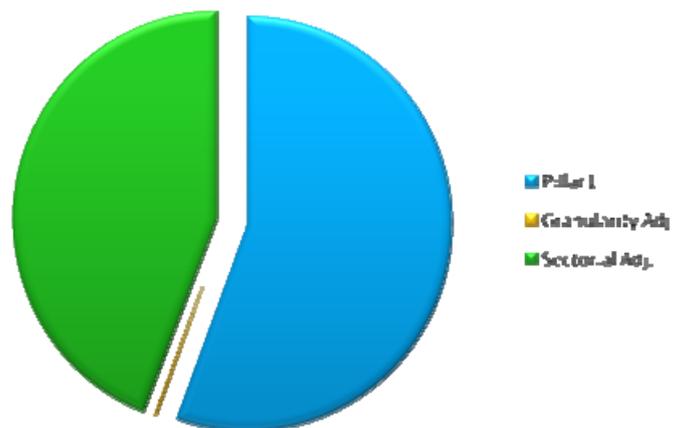
Perfomance

The model computes the Credit Var and the other risk measures in an analytic fashion. This means that the results are quickly and accurately produced.

We tested the performance of CreVar in a realistic setting:

- Five macroeconomic factors
- 11 industrial factors
- 20 default probability classes
- 20 loss-given-default classes
- 3 classes of specific contagion factors
- 500,000 contracts

We used for the hardware:

- Intel 2 CPU (2,4 Ghz) Esa-Core.
- 32 Gbyte di RAM.
- Windows 2008 R2 Enterprise.

The computation time has been slightly less than 20 minutes. The performance is excellent, compared to Montecarlo computations usually taking hours to yield the same result.

Quick responses when calculating the Credit VaR mean the possibility to effectively test the portfolio if new contracts are introduced or in specific economic scenarios, vastly enhancing the Bank's risk management tools.

## Other Tools

Incremental VaR

CreVar allows to quickly and precisely compute the variation of the Credit VaR of a portfolio when a new loan is added or an existing one is removed. The computation is analytic also in this case and the Bank can easily determine the impact of new operations with clients or of new commercial policies onto the Economic Capital so to better evaluate their profitability.

Stress Tester

CreVar allows also to perform a wide variety of stress tests complying with the Basel II requirements.
Two types of stress tests are possible:

- *Type-I stress tests*: they measure the reactivity of the losses to a change of the starting values of the model's inputs: the probabilities of default (PD), the loss given default (LGD), correlations, … Type-I stress tests can be seen, under a different perspective, as tests for the model risk, as far as the initial level of the inputs is concerned.
- *Type-II stress tests*: they compute the amount of losses experienced if one, or a combination, of the risk factors will assume some values in the future, along and/or at the end of the considered period. In this case we are actually computing a conditional measure of the losses (e.g.: a conditional VaR). From a slightly different point of view we want to know what happens if we force one or many risk factors to assume predefined values. For this kind of stress tests, the model consistently computes the new risk factors' conditional correlation matrix and the new obligors' conditional probabilities of default. The figure below shows how the PD of an obligors varies as the risk factor GDP is set at different levels running from -5% to 5%.
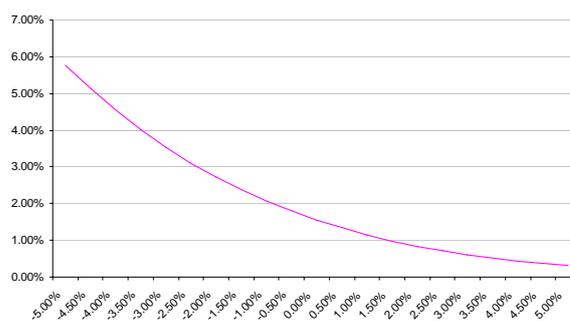
Capital Allocation

Allocation of the absorbed capital is essential to correctly evaluate the performance of single business units and their actual contribution to the total profitability of a bank.

CreVar allocates Economic Capital amongst different business units accordingly to the actual risk generated by their activity.

To overcome the inconsistency of the VaR measure, the allocation is operated by means of the Expected Shortfall measure.

Commercial Policies' Optimizer

The fast and accurate analytical computation of the Credit VaR makes possible to run an optimization over several possible future commercial policies. The optimizer generates an efficient risk (VaR)/return (spread over Libor) frontier, by minimizing the Expected Shortfall. The VaR is strongly linked to the Regulatory Capital in our framework, so the Bank can evaluate the profitability of the new policies.

New commercial policies are defined in terms of variation of the portfolio under one or more constraints referring to:

- single obligors,
- cluster of obligors, identified by common features (same PD, belonging to the same sectors, ...). Clusters can be already existing or created as new ones,
- specific sectors,
- specific contracts.

An example of efficient frontiers for different levels of Expected Shortfall is shown below.
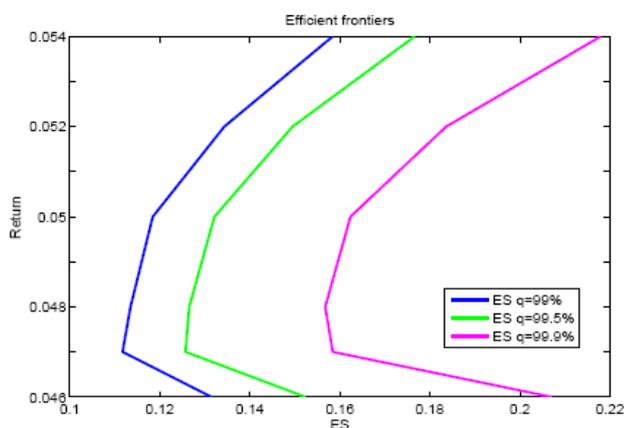
The efficient frontier VaR/return is then derived from these.
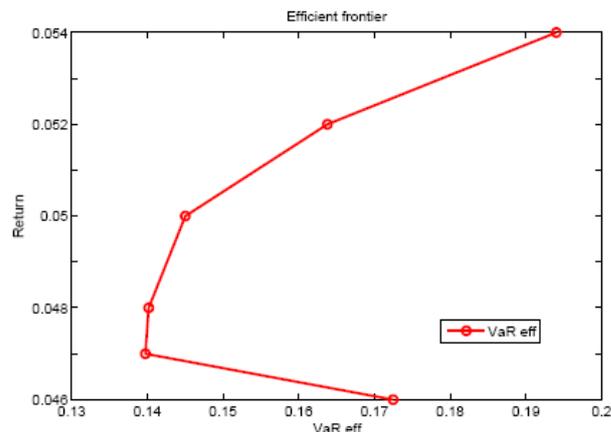
Theoretical Background

Iason always strives to thoroughly design models up-to-date with the cutting edge research and with the best practice in the banking industry.

At the same time, Iason strongly believes that models should not be black boxes and that they should be fully disclosed to the users. For these reasons we make publicly available all the theoretical background via technical documentation retrievable in the internet.

The Credit VaR engine within the CreVar application has been build according to the model explained in the documents *Basel II Second Pillar: An Analytical VAR with Contagion and Sectoral Risks* and *Analytical Credit VAR with Stochastic Probabilities of Default and Recoveries*, both downloadable at:

http://iasonltd.com/resources.php

About Iason

Iason is a company created by market practitioners, financial quants and programmers with valuable experience achieved in dealing rooms of financial institutions.

Iason offers a unique blend of skills and expertise in the understanding of financial markets and in the pricing of complex financial instruments.

The company's structure is very flexible and grants a fully be spoke service to our Clients.
Its flexibility and its mix of people that implement innovative solutions and test their suitability in real market environments are the distinguishing features of Iason.

For further information on CreVar and other Iason's services, please write to us at info@iasonltd.com .

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