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OVERVIEW OF THE CENTRAL BANK OF MALTA'S APPROACH TO ALIGN ITS CREDIT RISK THRESHOLD MODEL TO IFRS 9 CLASSIFICATION OF LOANS

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BOX 3: OVERVIEW OF THE CENTRAL BANK OF MALTA'S APPROACH TO ALIGN ITS CREDIT RISK THRESHOLD MODEL (CRTM) TO IFRS 9 CLASSIFICATION OF LOANS[1]

The CRTM is a Merton-type model based on Monte Carlo simulations to quantify credit risk arising from new defaults within a portfolio of loans. While the classification of new non-performing loans (NPLs) constitutes one observation of actual transitions from performing loans to NPLs, in practice this outcome originates from a wide variety of individual outcomes and circumstances that would have materialised during the year of review. To this end, the CRTM was first introduced in Box 5 of the *Financial Stability Report* 2013 to assess the performing loan portfolio on an individual bank basis and generate a loan loss distribution via simulations of these alternative scenarios. In turn, an assessment of the adequacy of banks' capital in absorbing different levels of loan losses arising from the simulated alternative scenarios is conducted.

A main feature of the update being presented in this box is the alignment of the CRTM to the classification of loans into three stages defined in the International Financial Reporting Standard 9 – Financial Instruments (IFRS 9) issued by the International Accounting Standards Board (IASB). The CRTM was originally based on the International Accounting Standard 39 (IAS 39) issued by the IASB which recognised impairments on an incurred loss approach, i.e. the recognition of impairment losses occurs after there is objective evidence of credit losses. IAS 39 has since been replaced by IFRS 9 which includes an expected credit loss (ECL) framework as a forward-looking approach for the recognition of impairments on financial instruments. In particular, impairments on loans are calculated on the basis of a 12-month ECL (12mECL) or a lifetime ECL (LTECL) depending on the stage of a loan. The former recognises potential losses arising from a loan default over the next 12 months, while the latter recognises potential losses that could arise over the entire term of the loan. Thus, apart from the manner in which provisions are quantified, the traditional model of classifying loans as either performing or non-performing has in the recent years migrated to a 3-stage classification as follows and as summarised in Table 1.

Stage 1 – Loans are classified in this category upon inception, and this relates to the performing category. Impairments would be calculated as per the 12mECL approach. For the purposes of capital requirements, risk-weighted assets (RWAs) are calculated under the standardised approach by multiplying the loan exposure by the corresponding risk-weight assigned to performing loans.[2]

Table 1
IFRS 9 COMPUTATION OF EXPECTED CREDIT LOSSES AND RISK WEIGHTS

	IFRS 9 ECL framework	Computation of RWA
Stage 1	12mECL	Apply the risk weight corresponding to performing loans
Stage 2	LTECL	Apply the risk weight corresponding to performing loans
Stage 3	LTECL	Apply the risk weight corresponding to NPLs

Source: Central Bank of Malta calculations.

[1] Prepared by David Stephen Law, Principal Quantitative Analyst within Policy Crisis Management and Stress Testing Department. The author would like to thank Alan Cassar, Chief Officer Financial Stability and Statistics Division and Christine Barbara, Manager within Policy Crisis Management and Stress Testing Department, for their valuable suggestions.

[2] While Article 107 of the Capital Requirements Regulation allows banks to determine capital requirements under the standardised approach (SA) or the internal ratings based approach (IRB), all banks operating in Malta follow the SA.

Stage 2 – Loans are classified in this category if they experience a *significant increase in credit risk* (SICR). While RWAs would still be calculated as for Stage 1, banks would need to estimate impairments set aside for these exposures according to the LTECL approach, which would result in a higher provisioning rate when compared to the 12mECL.

Stage 3 – Loans are classified in this category if there has been an incurred loss event and thus would be comparable to the category of NPLs. Loans classified in this stage would be assigned higher risk-weights applicable to NPLs while impairments remain computed according to the LTECL approach.

In order to simulate alternative scenarios, the CRTM generates the underlying asset value of each borrower. This is an unobserved (latent) variable which by design is standard normally distributed and modelled as a combination of idiosyncratic and sectoral shocks, as follows:

$$X_{i,s,j} = r_s Y_{s,j} + \sqrt{1 - r_s^2}\,\varepsilon_{i,s,j}$$

Where:

$X_{i,s,j}$ is the simulated asset value of borrower *i* in sector *s* in simulation *j*

r_s represents a sectoral factor weight and takes values between 0 and 1

$Y_{s,j}$ is a standard normal random number adjusted for the correlation matrix of sectoral NPL ratios, representing an exogenous shock

$\varepsilon_{i,s,j}$ is a standard normal random number representing the borrower specific (idiosyncratic) risk factor

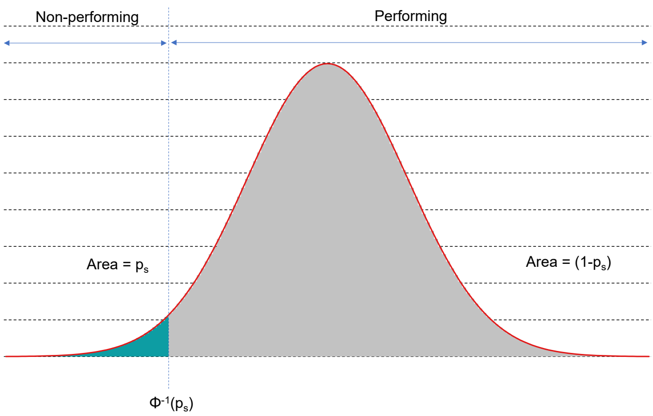
In the original version of the CRTM, a performing loan is deemed to become an NPL if its underlying asset value $X_{i,s,j}$ drops below the credit risk threshold whose value is linked to the sectoral probability of default p_s, as follows:

$$X_{i,s,j} < \Phi^{-1}(p_s)$$

where $\Phi^{-1}(p_s)$ is the value of the inverse standard normal distribution corresponding to the respective sectoral probability of default.

Chart 1 shows the distribution of the underlying asset value ($X_{i,s,j}$) and the credit risk threshold (given by the vertical line) which indicates the point at which a performing loan becomes non-performing. The Monte Carlo engine draws values for $X_{i,s,j}$

Chart 1
DISTRIBUTION OF UNDERLYING ASSET VALUE BY PERFORMANCE STATUS



Source: Central Bank of Malta calculations.

from this distribution to determine whether the performing loan at the beginning of the period remains performing or becomes an NPL by the end of the period.

To incorporate the IFRS 9 classification of loans, the updated CRTM had to depart from a binary classification (performing or non-performing) to consider a three-stage approach. This implies that the credit risk threshold is no longer linked to a single parameter (the probability of default) but to nine transition probabilities summarised in a 3-by-3 transition matrix, as follows:

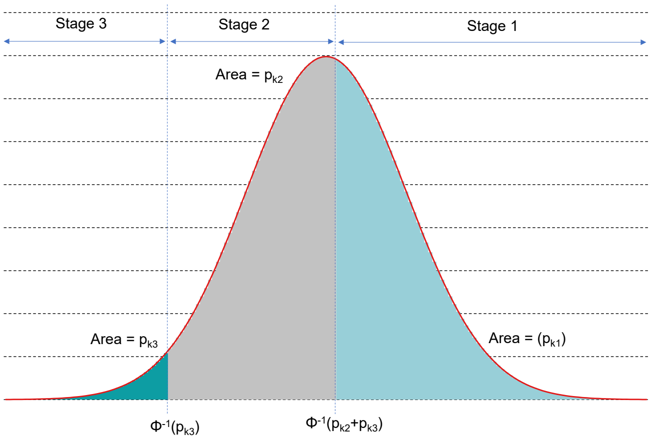
$$Transition\ Matrix = \begin{pmatrix} p_{11} & p_{12} & p_{13} \\ p_{21} & p_{22} & p_{23} \\ p_{31} & p_{32} & p_{33} \end{pmatrix}$$

Where each entry of the transition matrix p_{kl} represents the probability for a borrower classified as IFRS 9 Stage k at the beginning of the period, ending up in Stage l by the end of the period.

Chart 2 shows the distribution from which the Monte Carlo simulation can draw the value of $X_{i,s,j}$ and determine whether the loan currently classified as either Stage 1, 2 or 3 at the beginning of the period remains in the current stage or transitions into either of the other two stages by the end of the period.

Implicitly, instead of a single sectoral credit risk threshold, the CRTM now has a total of six credit risk thresholds (two thresholds for each of the three IFRS 9 stages) to determine transitions as per Table 2.

Chart 2
DISTRIBUTION OF UNDERLYING ASSET VALUE BY IFRS 9 STAGES



Source: Central Bank of Malta calculations.

Table 2
IFRS 9 COMPLIANT CREDIT RISK THRESHOLDS

Initial Stage	Final Stage	Threshold
Stage 1	Stage 3	$X_{i,j,s} < \Phi^{-1}(p_{13})$
	Stage 2	$\Phi^{-1}(p_{13}) <= X_{i,j,s} < \Phi^{-1}(p_{12}+p_{13})$
	Stage 1	Otherwise
Stage 2	Stage 3	$X_{i,j,s} < \Phi^{-1}(p_{23})$
	Stage 2	$\Phi^{-1}(p_{23}) <= X_{i,j,s} < \Phi^{-1}(p_{22}+p_{23})$
	Stage 1	Otherwise
Stage 3	Stage 3	$X_{i,j,s} < \Phi^{-1}(p_{33})$
	Stage 2	$\Phi^{-1}(p_{33}) <= X_{i,j,s} < \Phi^{-1}(p_{32}+p_{33})$
	Stage 1	Otherwise

Source: Central Bank of Malta calculations.

Estimating portfolio-specific characteristics from the simulated transitions

Although the simulations of new borrower defaults involve random draws from a given probability distribution, which are in turn benchmarked against the sectoral-specific thresholds (see Table 1), the quantification of losses involves the use of borrower characteristics at the individual loan level. Indeed, the 12mECL and LTECL are calculated for each borrower on the basis of the outstanding balance, the interest rate charged and the term-to-maturity of each loan. Similarly, the change in risk-weighted assets is calculated for each loan on the basis of the sector and collateral backing the loans.

At the end of each simulation, the CRTM generates the value of loan losses for an alternative scenario as the sum of 12mECL for loans ending in Stage 1 and LTECL for the remaining loans classified as Stage 2 or Stage 3. Combining the loan losses from each simulation produces an empirical distribution of impairments at portfolio level. Unlike the underlying asset value $X_{i,s,j}$ which is standard normally distributed by design, the shape of the loss distribution is not determined in advance but generated entirely from the characteristics of the loan portfolio being assessed, i.e. the sectoral composition of the loan portfolio and the underlying risk of default as captured by the transition matrices. This portfolio-specific distribution is then used to infer three credit risk parameters: (i) the Expected Loss (EL), which is equal to the average of the distribution, (ii) the Absolute Value at-Risk (VaRα), which as the α-percentile of the distribution represents both expected and unexpected losses at the α-level of confidence and (iii) the Expected Shortfall (ES), which captures the mean of the right tail of the distribution for the losses exceeding the VaRα. Unlike the VaRα, the ES is a consistent parameter which represents an extreme (right) tail event, i.e. the high-impact loss event with an extremely low probability of occurrence.

Possible uses of the model and way forward

This model is primarily designed to act as a tool for credit risk quantification with credit risk thresholds inferred from sectoral default rates as observed at the reference date. The aforementioned three credit risk parameters are determined to assess the adequacy of bank provisions to cover credit risk losses prevailing in the loan portfolio. The output of the model could be used as a challenger model to assess the adequacy of banks' provisioning and inform analyses conducted within the Financial Stability Departments.

Moreover, the model will be extended to tap into its potential of stress testing banks' resilience to particular risks. By means of increasing transition probabilities from the higher into lower stages (i.e. p_{12}, p_{13} and p_{23}), the model could be used to quantify increases in sectoral risks. Similarly, shocks may be applied to granular information at the borrower level to test the impact of a devaluation of collateral backing the individual loans. Future work can be carried out to explore the possibility of linking the transition probabilities to macro-economic shocks. In the case that a significant relationship exists between the sectoral transition probabilities and explanatory macro-economic variables, then the output of the CRTM could also enhance the Macro Stress Testing framework's quantification of credit risk in the loan portfolio.