Summary of review and validation of MARQ methodology

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1. Introduction

1.1. Overview

This report summarises Oliver Wyman’s independent review of the MARQ methodology, a dimensionless score between 0 and 1500 that represents relative collateral risk of a residential or small commercial mortgage loan. The review was conducted by Oliver Wyman for Mòrgij Analytics prior to entering into an agreement with Perpetual and Mòrgij Analytics to found MARQ Services, a joint venture providing standardised data, reporting and analytics (including MARQ Scores) to professional and institutional investors in Australian RMBS and Covered Bonds.

Oliver Wyman’s conclusion based on this review is that the risk calculation methodology underlying the MARQ Score represents a sound and appropriately comprehensive method for assessing the relative risk of mortgage loan collateral. This finding is made in the context that MARQ Services, through the user defined risk weight functionality, is intended to provide a toolset for risk analysis rather than an absolute measure of mortgage risk. Moreover, the score is designed to be predictive of relative risk in a range of market conditions rather than the best possible predictor at any given point in time.

The report presents three findings based on the review undertaken:

1. The loan characteristics included in the MARQ methodology capture all important risk characteristics of mortgages given the methodology’s intended scope

2. The MARQ score is able to predict the risk inherent in a mortgage by incorporating the loan characteristics in an appropriate manner in terms of directionality and importance
   - Each Loan Risk Characteristic impacts the MARQ score in a direction which is consistent with industry practices and expected impact on risk
   - The Standard Risk Weights\(^1\) (multipliers assigned to each Loan Risk Characteristic or ‘LRC’) reasonably reflect the relatively importance and direction of impact of each LRC on the riskiness of a mortgage

3. Mòrgij Analytics has established reasonable guidelines to enable processing of Loan Characteristics (i.e. required input data for the MARQ Score) in case they are unavailable, so that a score can be meaningfully calculated without complete information

\(^1\) See section 1.2 for detailed explanation
1.2. The MARQ methodology

The MARQ score is a dimensionless score between 0 and 1500 that represents the relative collateral risk of a residential or small commercial mortgage loan. It is based on a number of risk factors (also called ‘Loan Risk Characteristics’ or LRCs) that include characteristics of the borrower, the security property, and the terms of the loan. In addition to these ‘Loan Risk Characteristics’, the MARQ platform also collects and stores data for more than 25 ‘Other Loan Characteristics’ which are not used in the MARQ score calculations, but contain important information that may affect a user’s understanding of the risk inherent in a portfolio. MARQ scores are available to professional and institutional investors via MARQ Services (www.MARQservices.com). The MARQ Services website is also referred to in this document as the ‘MARQ platform’.

Calculation of a MARQ score\(^2\) for a given loan consists of the steps outlined in Figure 1. A base risk score (Base CRQ) is first determined as a function of Loan to Value Ratio and Documentation Type. This is then successively multiplied by adjustment factors that depend on the value of different Loan Risk Characteristics. Next, caps and floors are applied to the resulting risk score. Further adjustments are made to account for factors such as foreclosure costs and property price decreases. The final risk score (CRQ score) is then converted to a MARQ score using a logarithmic conversion. The calculation is described in further detail below.

\(^2\) As described in the document ‘MARQ Services Specifications’ at www.MARQservices.com.
Detailed description of the steps involved:

1. **Determination of Base Credit Risk Quantity**: The first step is to determine a Base CRQ for a loan. Base CRQ scores are an assessment of the relative riskiness of loans based on LVRs (Loan to Value Ratio) and Documentation Types alone.

2. **Application of Risk Weights**: Risk Weights are multipliers assigned to each Loan Risk Characteristic determined by the values it assumes. These Risk Weights are multiplied with the Base CRQ to calculate an adjusted CRQ score. Risk Weights are set by default to the Standard Risk Weights defined by Môrgij Analytics. Users can readily update the Standard Risk Weights in the MARQ Platform with their own User Risk Weights to reflect their own specific view of risk.

3. **Application of maxima and minima**: The CRQ score obtained in step 2 is modified to conform to specified maximum and minimum levels.

4. **Adjustment for foreclosure costs**: After the application of maxima and minima, the CRQ score is increased by a percentage amount representing an allocation to foreclosure costs in the event the loan defaults.

5. **Adjustment for property category**: The CRQ score is then increased further by a percentage amount representing the increased risk associated with certain property types and characteristics, for example, vacant land or property under construction.
6. **Adjustment for very high LVR:** Where the Loan to Value Ratio exceeds 120%, the CRQ score is increased to account for the increased exposure.

7. **Calculation of MARQ score:** The final CRQ score obtained is converted to a MARQ score between 0 and 1500 using a logarithmic formula:

\[
MARQ \text{ Score} = \min \left[ 1500, 296 \times \ln \left( \frac{\text{CRQ Score}}{100} + 1 \right) \right]
\]

The MARQ platform produces Standard MARQ scores or User MARQ scores. The Standard MARQ score is designed to provide a central (applicable across a range of market participants) “through the cycle” assessment of risk for an average Australian mortgage. The Standard MARQ score should not be interpreted as a definitive risk assessment that can be applied universally to all mortgages or as an assessment of mortgage behaviour under economic downturn conditions. Instead, the MARQ platform enables the user to parameterise the model appropriately for such conditions, and to perform stress testing.

### 1.3. Scope of MARQ methodology

Oliver Wyman’s review of the MARQ methodology is based on the following intended scope of application:

- Loans underwritten in Australia payable in Australian dollars. Currency risks are therefore not considered.
- Retail mortgages and retail-like small-commercial loans to SMEs, i.e. where a personal financial guarantee from the owner is obtained. Large commercial mortgages are not intended to be in scope.

Moreover, the MARQ score is designed to:

- Assess the standalone risk of the mortgage only. It does not incorporate the effect of mortgage insurance or any other guarantees on the overall risk profile of the mortgage.
- Measure the relative risk of a single mortgage asset as well as the aggregate risk profile of a pool of mortgages with varying characteristics. The MARQ score deliberately does not include assumptions on correlations between individual mortgage assets within a portfolio. Portfolio level correlation effects can be investigated in part through the ability of the user to stress house price indices and income levels at a regional level, directly impacting mortgage performance without assuming any particular level of correlation. Regional stress testing allows users to assess impacts of regional stresses including floods, forest fires and city specific economic stresses.
- Evaluate individual mortgage risk and does not differentiate portfolios based on loan concentration since it is meant to be a pure measure of collateral quality.
- Provide a relative indicator of the risk characteristics of the mortgage asset with respect to the borrower, loan and security property only. Hence, factors such as
the origination channel, servicer, or securitization structure for RMBS, which would be a prerequisite to determining the absolute risk profile, are absent. Some of these factors may be considered for future updates to the MARQ toolkit.

- Provide a dimensionless indicator of standalone risk in a single mortgage. In other words, a mortgage asset with a MARQ score of 200 is less risky than mortgage assets with MARQ scores of 201 or higher, and more risky than mortgage assets with MARQ scores of 199 or lower. However, it is not necessarily twice as risky as a mortgage with a MARQ score of 100. Hence, the MARQ score does not translate to an absolute level of risk, measured in any way, either with reference to expected loss or expected level of credit support.

In summary, MARQ is intended to be an ordinal dimensionless indicator of standalone risk on a single mortgage asset, underwritten in Australia payable in Australian dollars, on a purely relative basis.

2. Comprehensiveness of factors

The MARQ data inputs capture all the most important risk characteristics of mortgages for the intended purpose of the MARQ methodology and the data inputs are in line with international Asset Backed Securities reporting standards currently enforced in Europe and standards recommended by the Australian securitisation industry (e.g. the ASF standards).

Oliver Wyman compared the Loan Risk Characteristics and Other Loan Characteristics included in the MARQ platform with factors used in models from all major rating agencies and seventeen industry models used by mortgage lenders globally for credit risk measurement (including examples from North America, Europe, Middle East, Asia and Australasia). In addition, MARQ data standards were compared with regulatory guidelines such as the loan-level disclosure standards of the European Central Bank (ECB)\(^3\) and the Australian Securitisation forum (ASF)\(^4\).

Most importantly, the MARQ methodology considers each of the “5 Cs of credit”.

1. **Capacity** of the borrower to service the debt obligation is measured through the NSR (Net Servicing Ratio), as well as differentiated curves for income documentation levels.

2. **Collateral** attached to the loan sets the base curves through the LVR (Loan to Value Ratio), and in addition is adjusted for based on the property type factor.

3. **Capital** of the borrower is accounted for through differentiation of whether the loan was taken out as refinance on an existing loan and whether the borrower is a first home owner, as well as through LVR. Cash out refinancing (which may suggest potential limitations in borrower capital) is also captured in the score.

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4. **Character** of the borrower is measured based on past credit history. At the time of writing Comprehensive Credit Reporting is not yet in force in Australia – accordingly this is based on negative credit history only.

5. **Conditions**, e.g. intended purpose of the loan, are accounted for by the occupancy factor as well as by the cash-out refinancing factor.

3. **MARQ score calculation**

Oliver Wyman is satisfied with the ability of the MARQ score to predict the risk inherent in a mortgage on a relative basis by incorporating the loan characteristics in an appropriate manner. Oliver Wyman’s view is based on an assessment consisting of two approaches - factor directionality and factor calibration.

3.1. **Factor directionality**

Oliver Wyman observed that for all Loan Risk Characteristics, the directionality of the Standard Risk Weight impact on the MARQ score was intuitive and in accordance with international credit risk practices and industry thought papers. For example, international credit risk practices commonly identify mortgage owners who provide a low level of documentation as more risky than those who provide full documentation; this is reflected in the Standard Risk Weight applied for mortgage holders with low documentation which results in a higher MARQ score (indicating a higher risk) than for full doc.

3.2. **Factor calibration**

The MARQ score is determined by a Base CRQ score which is successively multiplied by parameters (risk weights) that are determined by the value of each Loan Risk Characteristic. The risk weights applied in the MARQ calculation are intended to be based on the user’s view of risk specific to the portfolio being analysed and the scenario being assessed. The MARQ analytics platform does however provide Standard Risk Weights for initial analysis which are intended to represent a central view of risk (applicable across a range of market participants) for an average Australian mortgage based on an average or “through the cycle” economic environment. The Standard Risk Weights which define the slope and curve of each continuous adjustment factor have been developed by the Mòrgij Analytics team based on observations from comparable models from industry participants, and expert judgment gained from extensive professional experience in banking, capital markets, structured finance, risk management and mortgage origination.

Oliver Wyman found that the Standard Risk Weights used by the MARQ platform provide a reasonable assessment of the magnitude and direction of impact of each Loan Risk Characteristic on the riskiness of a mortgage. Oliver Wyman’s assessment is based primarily on qualitative, expert assessment, but including a limited quantitative analysis of the predictive power of the Standard Risk Weights using historical data within the Australian market. Oliver Wyman will use the data
collected by MARQ Services to monitor and verify the performance of the Standard Risk Weights on an ongoing basis in order to extend and update this analysis.

Oliver Wyman was also satisfied with the methodology used and the relative impact of the application of non-linear adjustments to account for loss factors such as foreclosure costs and potential declines in property value.

4. Treatment of unavailable data

Recognising that, in some cases, Loan Managers may be unable to fully comply with the MARQ data requirements, Mòrgij Analytics has provided guidelines and standards to accommodate and enable the processing of unavailable data. Oliver Wyman has reviewed these guidelines and found them to be reasonable in their approach. Indeed these ‘data completion’ approaches are similar conceptually to those used by major banks in their internal credit assessment frameworks for regulatory capital under Basel II.

Mòrgij Analytics has developed the following types and standards of loan-level data for each Loan Characteristic:

**Actual Data** refers to data whose source is loan-level data maintained in the electronic records of the Loan Manager. Actual Data is either:

- Data where the value reported to MARQ Services is equal to the value of the data in the Loan Manager’s records
- Data where the value reported to MARQ Services is an objective function of the values of data in the Loan Manager’s records

**Inferred Data** refers to data that is not Actual Data, but where the values of the data have been inferred or estimated by the Loan Manager on the basis of relevant information such as underwriting standards, or ancillary data.

**Assumed Data** refers to data that is neither Actual nor Inferred. Assumed Data includes data where the Loan Manager has simply made a blanket assumption (whether or not supported by relevant information) of the value for a Loan Risk Characteristic for an entire pool, without differentiating between different individual loans.

Certain Loan Risk Characteristics such as Current Balance and Loan to Value Ratio are considered ‘Critical’, with no inference basis or assumed value. Where an issuer is unable to provide these Loan Risk Characteristics, it is not possible to assign a reasonable value and a meaningful MARQ score cannot be calculated.

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5 Refer to the document ‘MARQ Services Data Verification Process’ at www.MARQservices.com
5. Conclusion

Oliver Wyman has concluded that the MARQ methodology presents a sound system for assessing the relative risk of mortgage loan collateral. Specifically:

- The methodology includes an appropriately comprehensive set of risk factors recognised globally as the key indicators of mortgage risk.
- The Standard MARQ score (derived using predefined Standard Risk Weights) provides a reasonable and defensible assessment of relative risk of mortgage loans for the Australian market based on expert assessment of mortgage risk behavior.

Our opinion is based on the fact that the Standard MARQ score is designed specifically to provide a starting point for users to form their own opinion on collateral risk of mortgage loans; it is not seeking to provide an opinion on or give an indication of absolute risk or a “rating” in any form.

6. Bibliography

The following MARQ Services documents can be found at www.MARQservices.com:

- MARQ Services Specifications
- MARQ Services Product Description
- MARQ Services Data Verification Process
- MARQ Services Data Requirements
- MARQ Services Analytic Function and Reporting
- MARQ Data Spreadsheet Template (Excel)
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