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COVID-19: Living Through the Stress Test of the U.K. Mortgage Market

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INTRODUCTION

The COVID-19 pandemic worsened the U.K. economic outlook dramatically between February and April. We use the Moody's Analytics Mortgage Portfolio Analyzer to quantify the impact of this significant economic stress on a portfolio of U.K. mortgages. The expected loss due to the downgrade of the baseline forecast soars by 76%, from 0.13% of exposure to 0.23% of exposure. We also consider downside alternative scenarios whose severity is linked to the baseline forecast. Conditional on economic status, a 1-in-10 recession implies an increase in the expected loss by 267%, from 0.27% to 0.98% of exposure. For a 1-in-25 recession, the expected loss skyrockets by 221%, from 0.58% of exposure to 1.87% of exposure.

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BY JUAN LICARI, PETR ZEMCIK AND ARMAN MKHITARYAN

Introduction

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In our investigation, we first characterize how the distribution of output projections shifts because of the impact of the pandemic. We next describe the Mortgage Portfolio Analyzer that is deployed to link the forecasts of economic drivers to risk metrics such as probability of default, prepayment, and loss given default. The projected risk vectors are used to calculate the expected loss over a five-year horizon as well as its distribution. We then report expected losses by account-specific characteristics and regions.

U.K. economy during the pandemic

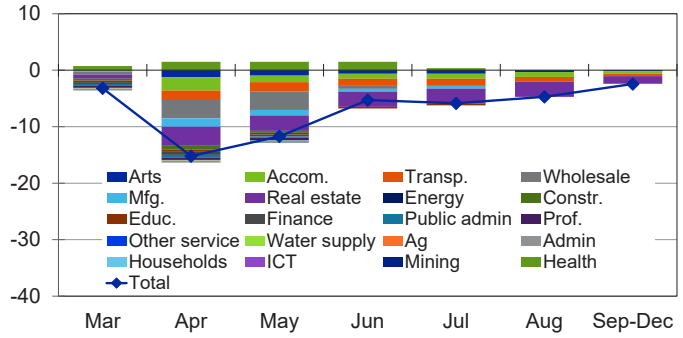
The COVID-19 pandemic has hit the U.K. economy hard, and pandemic assumptions are now a key part of Moody's Analytics macroeconomic forecasting.[1] Like other European countries, the U.K. is now preparing to gradually lift the lockdown measures it imposed on March 23. The criteria to relax some of the restrictions set by the U.K. government depend on the number of infections in the country and subsequently on the number of deaths. To calibrate the projection of a GDP path, we look at the composition of GDP by industry. We then translate our epidemiological assumptions into the capacity utilization by industry by months. The utilization is determined by our view on how quickly the lockdown measures are lifted. The resulting GDP path for April is shown in Chart 1. The GDP level indicates a V-shaped recession, with initially a speedy recovery that slows down in the second half of the year.

The GDP path illustrates the new normal in light of the coronavirus pandemic. This prompts us to reassess the severity of our alternative stress scenarios. Using a Markov switching model, we generate 250,000 simulations of a GDP path over the next three years, taking into account the current status. We then tabulate the distribution of the average deviation from the April baseline (see Chart 2). To compare this with the outlook prior to the pandemic's full escalation, we include the February baseline GDP path in the chart, which is in

1 See "Calibrating Euro Zone GDP Growth for the Coronavirus Pandemic" by Kamil Kovar, Moody's Analytics (March 2020).

Chart 1: U.K. GDP Plunges in Q2

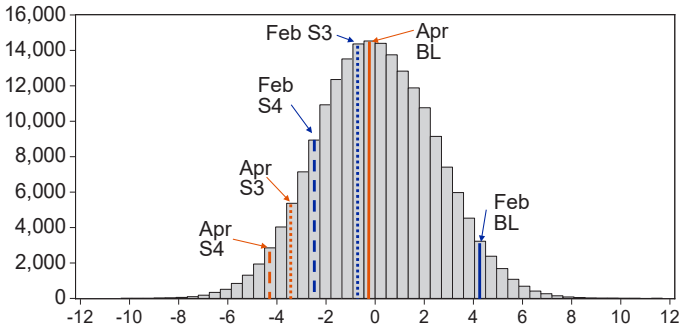
Ppt deviation from normal level of activity by industry, 2020



Source: Moody's Analytics

Chart 2: Severity

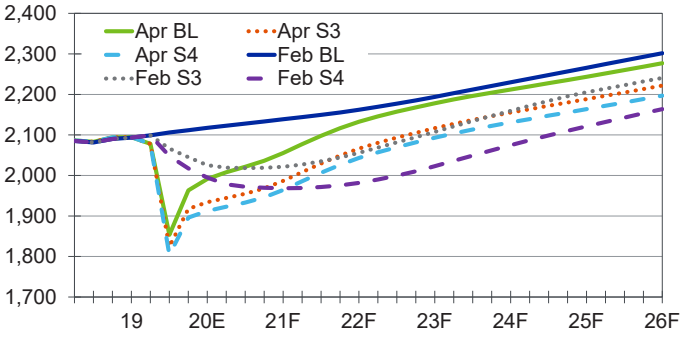
Avg ppt deviation from baseline



Source: Moody's Analytics

Chart 3: GDP Shift Between Feb and Apr

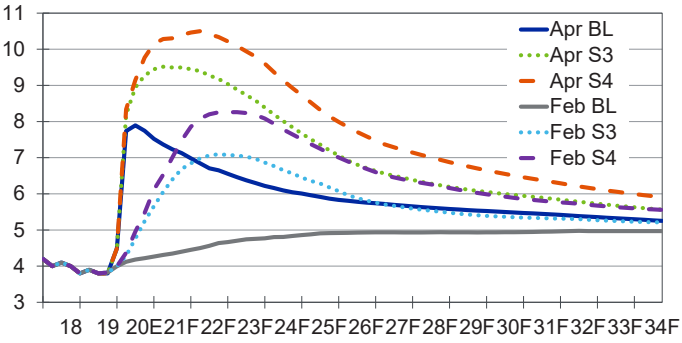
U.K. real GDP level, 2016£ bil



Sources: ONS, Moody's Analytics

Chart 4: Joblessness Rises

Unemployment rate, %



Sources: ONS, Moody's Analytics

the right tail of the distribution. Scenario S3 (based on internal numbering) has a severity of 10%. This means that 10% of the GDP paths have the average deviation from the baseline smaller than in this scenario. Scenario S3 is therefore a 1-in-10 recession, conditional on the baseline forecast, which is itself already a recession. Similarly, scenario S4 is a 1-in-25 recession and has a severity of 4%. We note that the February S3 scenario is close to the April baseline and that the February S4 scenario is close to the April S3 scenario. In other words, the April baseline forecast (our current economic outlook) would have been viewed as a stress scenario incorporating a 1-in-10 recession in the beginning of the year.

The forecast for GDP growth has been revised down several times between February and April. The difference between the baseline and stress scenarios in April and those in February is depicted in Chart 3. The April forecast would have been viewed as a 1-in-10 stress scenario at the beginning of the year (February S3). The GDP profiles differ as well. The February S3 recession starts more gradually and the GDP level stays depressed for an extended period, whereas the April baseline starts with a V-shaped recession followed by a relatively fast recovery.

Unemployment rates and house prices are key inputs in the risk models embedded in our U.K. Mortgage Portfolio Analyzer. The unemployment rate is estimated using a version of Okun's law and depends on the difference between actual and potential GDP (see Chart 4). Housing prices also reflect the unemployment rate and key interest rates, which are low in the downside scenarios (see Chart 5). This is a consequence of the Bank of England keeping the monetary policy rate close to zero.

Mortgage Portfolio Analyzer

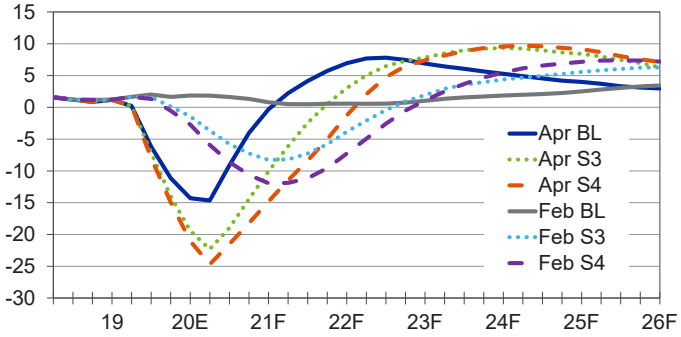
To stress a portfolio of mortgages, we employ our Mortgage Portfolio Analyzer. The U.K. MPA is an analytic tool to help measure and manage the risk of portfolios of U.K. residential mortgages. It encompasses a set of account-level econometric models used to generate both account-level and portfolio metrics. Chart 6 summarizes its key modules and functionality.

The MPA's central econometric models consist of loan-level models for default, prepayment, and loss given default. Charts 7-9 display the model structure and key drivers. These models are integrated into a multiperiod analysis to determine the cash flows and credit losses in a portfolio of residential mortgages. Some key features of the models and the portfolio analyzer platform are highlighted below.

The models incorporate a rich set of loan characteristics such as mortgage type, interest rate, loan term and outstanding balance; borrower characteristics such as income, employment and age; property characteristics such as region where the

Chart 5: House Prices Decline

House price growth, % change yr ago



Sources: ONS, Moody's Analytics

Chart 6: MPA Suite of Models

Modular structure

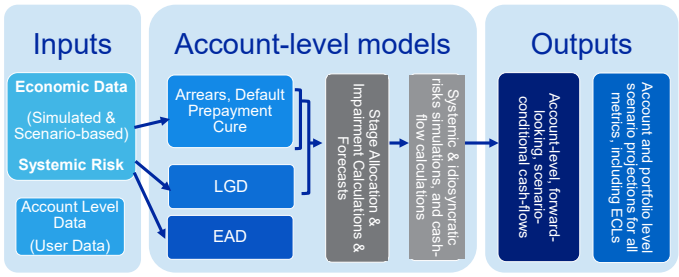


Chart 7: Default Model (PD)

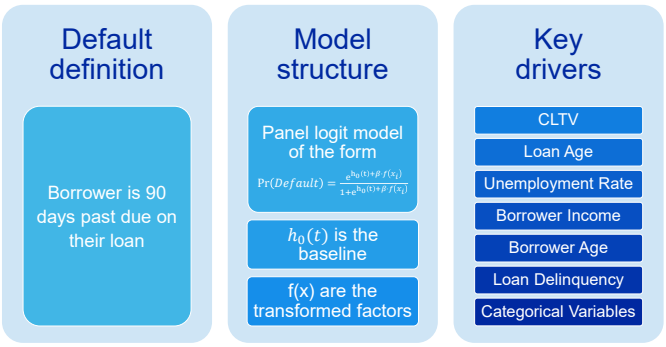
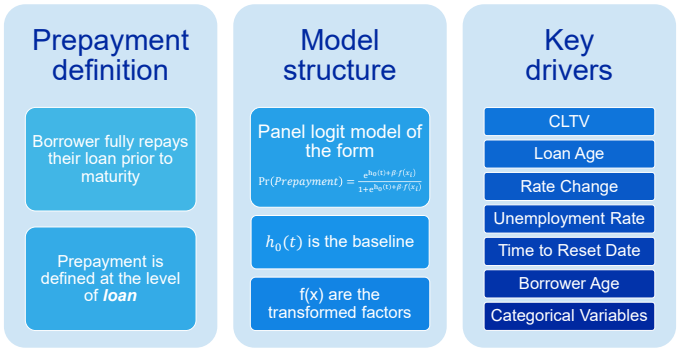


Chart 8: Prepayment Model (PP)



property is located; and macroeconomic factors such as changes in house prices and unemployment rates. The PD models also contain performance delinquency metrics such as days past due—this feature is exploited in stage allocation to calculate provisions according to the IFRS 9 standard.

The models are used in a multiperiod setting. Therefore, even if we want to analyze the credit risk in a mortgage over the life of the loan, using 30 years as an example, the expected loss over 30 years depends not just on the state of the economy at loan origination and maturity but also on the precise path taken by the macroeconomic variables during that time. For example, a rise in the house price index followed by a fall in the HPI will produce a different expected loss than will an initial fall in the HPI followed by a rise in the HPI, even if the final HPI is the same in both cases.

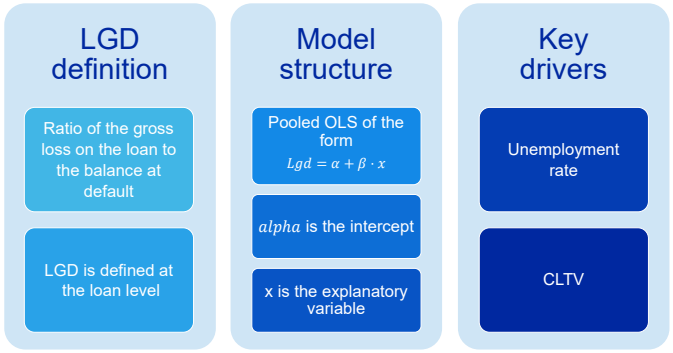
The correlation between the behavior of different macroeconomic variables and the correlation between the default probabilities of different borrowers are implicitly determined through their dependence on common factors.

Stress-testing a portfolio of U.K. mortgages

We analyze the impact of the rapidly changing economic environment on a portfolio of U.K. mortgages using a data snapshot from December 2019. The portfolio profile is captured in Table 1. The original data source is European Data Warehouse, which collects loan-level data for securitized mortgages. The total balance is over £31 billion and provides a representative sample of mortgages for the U.K. market for residential real estate.

The MPA analyzes mortgage portfolios in four steps. First, it generates the trajectories of economic scenarios at a quarterly frequency over the specified horizon. Next, for each loan in the portfolio the loan-level models calculate monthly default and prepayment probabilities over the target horizon as a function of loan-specific and economywide factors. Given these probabilities, the software then simulates default events, prepayment events, and loss given default, and aggregates the simulated losses across all loans in the portfolio for each trajectory. Finally, these simulated losses are themselves aggregated across all trajectories to produce an estimate of the distribution of portfolio-level losses. Historical economic data used for the simulations are updated quarterly. Additionally, in place of simulation users may construct their own macroeconomic forecasts of stress scenarios or use forecasts produced by Moody's Analytics to conduct credit risk analysis.

Chart 9: LGD Model



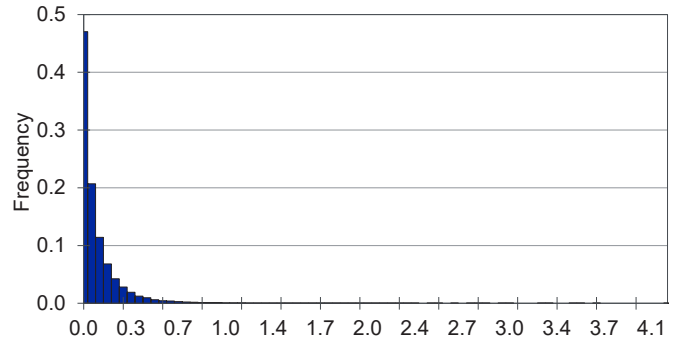
In addition to determining expected losses for the entire mortgage portfolio, it is also useful to consider the loss above or below a specific point on a distribution. In traditional risk management, this is commonly characterized as the Value at Risk (VaR). Once the loss distribution is available, the VaR can be easily obtained by looking at the quantiles of the loss distribution. In the MPA, this distribution is obtained using the Monte Carlo process, which simulates multiple economic paths of interest rate, unemployment and house price movements that serve as key inputs

Table 1: Summary Statistics for a Portfolio of U.K. Mortgages

Portfolio profile	
Total balance	£31,219,441,766.99
Total loan count	369,883
Wtd. avg rate	2.62%
Wtd. avg LTV	72.04%

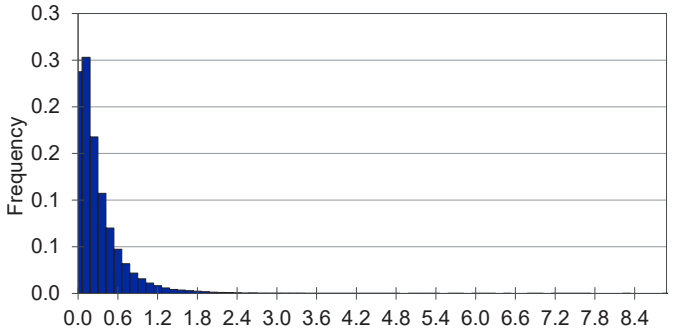
Sources: European Data Warehouse, Moody's Analytics

Chart 10: Loss Distribution, Feb 2020



Sources: MPA, Moody's Analytics

Chart 11: Loss Distribution, Apr 2020



Sources: MPA, Moody's Analytics

in determining the probability of a loan defaulting, prepaying or staying active in any period. The MPA anchors its simulation of 100,000 (default) economies around the economic scenario in a way that ensures that the mean value of each macro variable at each future point in time is the same as the actual forecast value of the scenario. In our case, we generate simulations around the baseline forecast and two downside scenarios, S3 and S4, both in February and April. Our results are captured in Table 2.

Table 2 contains the expected loss in a five-year projection. The histograms of the distribution for simulated expected losses for February are shown in Chart 10 and for April in Chart 11. In February, the loss was 0.13% of exposure. Given the economic status in February, the 1-in-10 recession S3 scenario implied an expected loss of 0.27%, while the 1-in-25 recession S4 scenario implied an expected loss of 0.58%. The baseline forecast adjustment reflecting the escalation of the pandemic resulted in an expected loss of 0.23%, close to the 1-in-10 stress scenario in February. The expected loss in the two downside scenarios also dramatically increased in April, to 0.98% for S3 and an extreme 1.87% for S4. The mean expected loss in 100,000 simulations was 0.12% in February and 0.36% in April, although the distribution of the expected loss was closer to being symmetric in April. This is also illustrated by the median being 0.06% lower than the mean of 0.12% in February. The mean and median were 0.23% and 0.25%, respectively, in April. The 1% VaR is 0.77% in February and 1.89% in April.

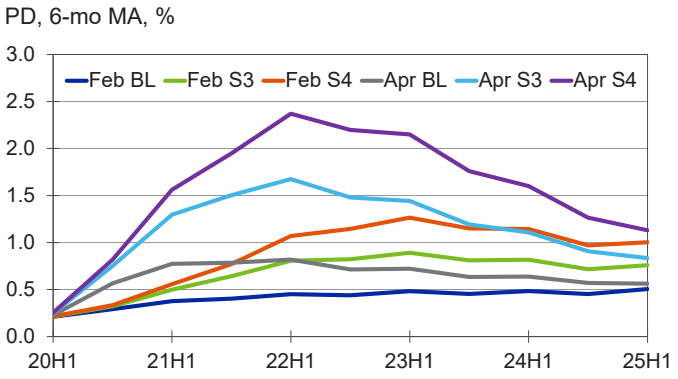
The PD and LGD risk vectors are depicted in Charts 12 and 13. The PD is seasonally adjusted by using a six-month moving average. As the PD model takes into account the impact of age on the probability of default, the PD curve generally rises due to origination of new loans whose PD peaks some two to three years since origination. However, there is a marked upward shift due to worsening economic conditions across the baseline forecast and the two downside scenarios. In the February baseline forecast, the PD peaks at 0.5% in the first half of 2025. By contrast, the April PD projection peaks at 0.8% in the first half of 2022. This is similar to the peak of the PD in the February S3 projection. The peak PD for the April projection in S4 reaches 2.4% in the first half of 2022. The LGD projections express just how much the evolution of losses since time of default depends on

Table 2: Expected Loss and VaR Between February and April

U.K. MPA - Feb 2020		U.K. MPA - Apr 2020	
Loss Summary Baseline Feb 2020		Loss Summary Baseline Apr 2020	
Expected Loss	0.1327	Expected Loss	0.2330
Loss Summary S3 Feb 2020		Loss Summary S3 Apr 2020	
Expected Loss	0.2662	Expected Loss	0.9764
Loss Summary S4 Feb 2020		Loss Summary S4 Apr 2020	
Expected Loss	0.5810	Expected Loss	1.8668
Aggregate Statistics Feb 2020		Aggregate Statistics Apr 2020	
Simulations	100,000	Simulations	100,000
Mean	0.115	Mean	0.362
Standard Deviation	0.162	Standard Deviation	0.392
InterQuantile Range	0.122	InterQuantile Range	0.334
Skewness	4.621	Skewness	3.911
Kurtosis	44.357	Kurtosis	32.706
95th/90th	6.362	95th/90th	4.305
VaR Summary Feb 2020		VaR Summary Apr 2020	
-100%	0.9520	-100%	2.2920
99%	0.7740	99%	1.8930
95%	0.4030	95%	1.0660
90%	0.2860	90%	0.7860
75%	0.1500	75%	0.4640

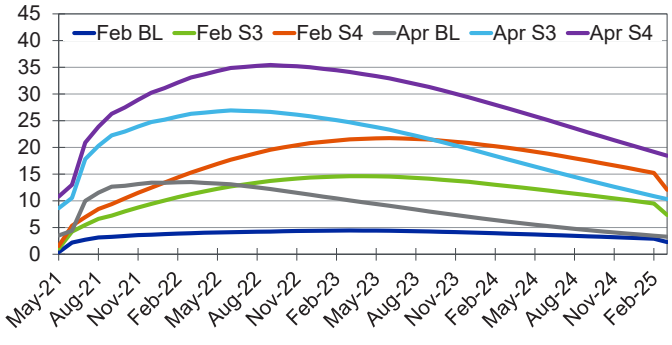
Sources: Moody's Analytics

Chart 12: PD Vector Shifts Upwards



Source: Moody's Analytics

Chart 13: LGD Increases



Source: Moody's Analytics

macroeconomic conditions. Although the losses do not break 5% in the February baseline scenario, they reach 13.5% in the April baseline scenario.

Expected loss distribution by account characteristics and regions

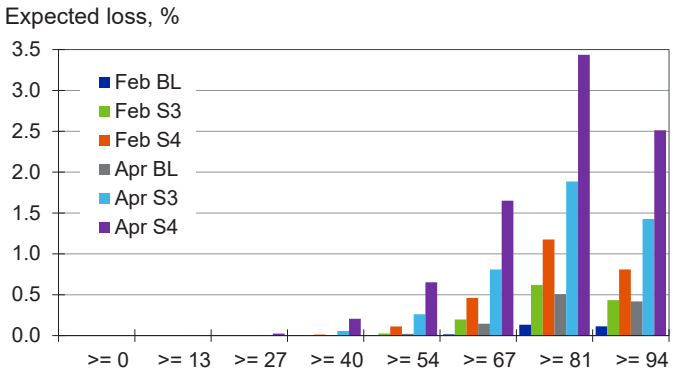
We further analyze mortgage loans by category, across the three projections made in February and in April. As expected, the higher loan-to-value ratios imply a greater probability of default, except for a small decline for LTV greater or equal to 94% (see Chart 14). For LTV greater or equal to 84%, the expected loss increases almost four times from 0.13% in the February baseline to 0.51% in the April baseline. In terms of occupancy (see Chart 15), the owner-occupied mortgages generally have the greatest likelihood of default, followed by buy-to-let mortgages and mortgages for second homes. The default rate jumps from 0.05% to 0.23% between February and April in the baseline forecast. The jump is similarly dramatic for the downside scenarios across occupancy categories. Due to the age-related profile of the PD curve, expected losses for vintages originating the last are the highest (see Chart 16). The expected losses again rise multiple times in each projection between February and April. Chart 17 depicts expected losses by status in December 2019. The expected loss on defaulted mortgages exceeds 3% in the April baseline forecast.

Next, we model HPI and the unemployment rate at the regional level. The growth rates of these variables depend on the growth rates of national-level variables. The regional HPIs and unemployment rates depend on the national HPI and the national unemployment rate. As both of these national indicators depend on GDP, the regional indicators implicitly reflect the GDP path. Changes in house prices in two different regions are correlated, since they depend on national house prices. Similarly, the correlation between changes in the unemployment rate in two different regions is captured through their dependence on the national unemployment rate. The greatest expected losses are recorded in the South-East, London, and the Eastern region (see Chart 18).

Conclusion

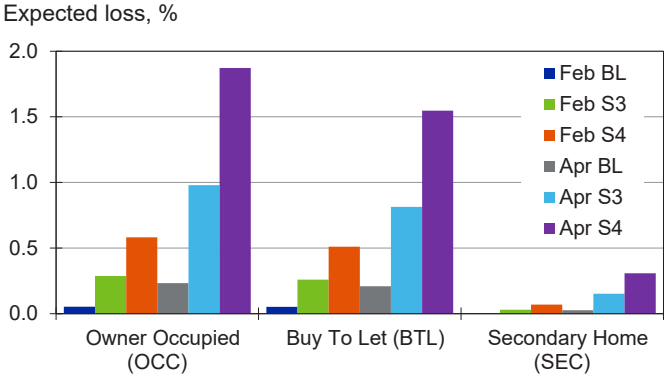
The economic stress experienced globally and by the U.K. is dramatic. At the moment, many financial institutions offer payment holidays for three months until June, so we can expect a wave of defaults in October, when payments on many loans will be overdue for 90 days or more. Expected losses have increased both for the baseline forecast and for the downside scenarios. The greatest losses will be incurred for recent vintages of owner-occupied mortgages in the South-East, London, and the Eastern region.

Chart 14: Losses Surge Across LTVs



Source: Moody's Analytics

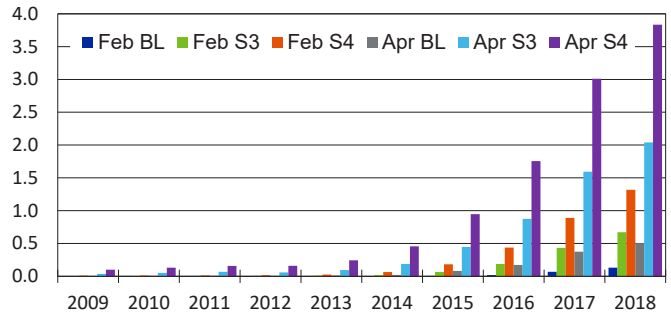
Chart 15: Owner-Occupied Loans Riskiest



Source: Moody's Analytics

Chart 16: High Losses for Recent Vintages

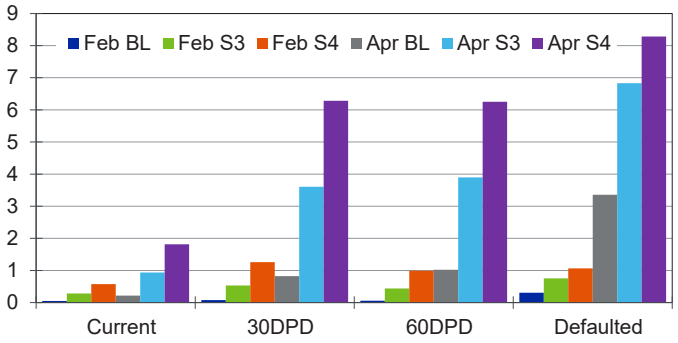
Expected loss, %



Source: Moody's Analytics

Chart 17: Expected Loss by Status

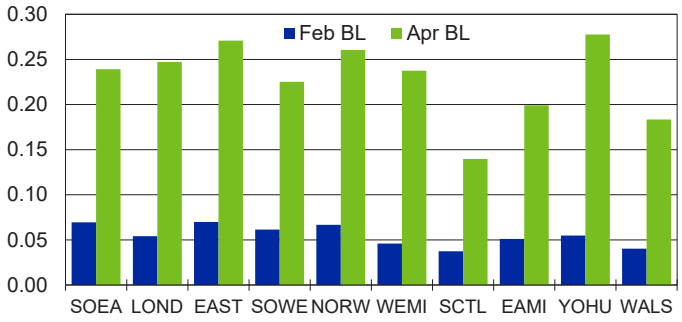
Expected loss, %



Source: Moody's Analytics

Chart 18: Expected Loss by Region

Feb vs. Apr baseline forecasts, %



Source: Moody's Analytics

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Arman Mkhitaryan is an associate economist for Moody's Analytics in the Prague office. Arman contributes to projects focused on IFRS 9 and stress-testing including data preparation, model development, validation and documentation. After graduation from Russian-Armenian University in 2016 with a bachelor's degree in economics, Arman began work as a financial analyst at SCDM Armenia. While working there he passed the CFA Level I exam. Afterwards he moved to Prague to pursue his master's studies at Charles University with a major in economics and finance. During his studies, Arman worked at WOOD & Company as an equity intern and at Eurex Clearing as a risk analyst.

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