MORTGAGE AND PROPERTY REPORT

MARCH 2019

Kensington

Welcome to the March 2019 edition of the Mortgage and Property Report. In this issue, we discuss the importance and use cases of mortgage loan level forecasting models, specifically Kensington's own "Vector" model, and use it to forecast loan performance in various Brexit scenarios.

Key Highlights

- Kensington has developed a proprietary loan level predictive modelling tool used to forecast the performance of UK residential mortgages
- It was developed in-house by Kensington's credit team over 10 years using Kensington's rich database of historical performance points for the UK mortgage market, with proven accuracy
- The model provides detailed insights into the performance of 2 different mortgage portfolios in various possible Brexit scenarios

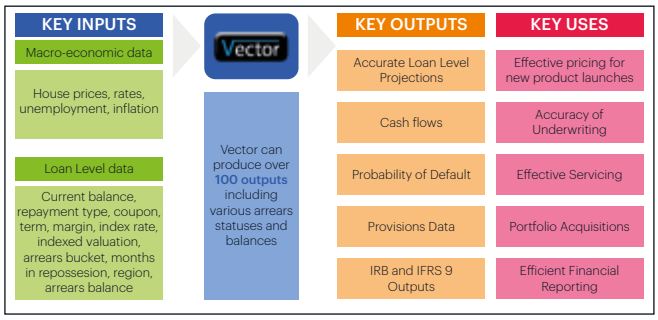
Model Background and Overview

Post credit crisis, the need to improve modelling capabilities was critical. Historically, in conventional mortgage portfolios or securitisation type models, constant default rates (CDR), constant prepayment rates (CPR) and loss severities were the sole inputs into the model. Further, given the uncertain macroeconomic environment it was not clear (i) how correct those usually user-defined inputs were, and (ii) how those inputs would change depending on changes in the economy e.g., if one's baseline expectation of CDR is 2%, what would a 20% house price drop do to that baseline expectation or how long that would take to materialise? Moreover, given the lag between a borrower falling into arrears and ultimately defaulting, a lender or servicer would not know if their model was right or wrong for years as these scenarios take a significant time to play out.

These issues are common when modelling mortgage performance in most jurisdictions. Significant academic research has been undertaken in the US market, with the Federal Reserve releasing a paper in 2015 on how to model mortgage performance. More recently machine learning has been used to improve these models including a model built by Kay Giesecke of Stanford University which applied deep learning techniques to develop a transition model based on the performance of 120 million loans. Links to all of these are provided at the end of this paper.

Over the last decade Kensington has developed its own proprietary model for the UK – Vector. Vector is an internally-developed loan level predictive modelling tool used to forecast the performance of UK residential mortgages under user-defined macroeconomic scenarios. It is a state transition model, which looks to forecast not just the propensity of a loan to default or redeem, but also the propensity to move between arrears statuses which means to worsen, to hold, or to improve (all of these collectively called roll rates) as a function of loan level characteristics and macroeconomic assumptions. This functionality translates into a very flexible model which can be used for various purposes. While most other asset models will provide a limited number of outputs such as cumulative defaults, losses and prepayments, Vector produces over 100 outputs on a monthly basis over the course of a loan's life in a given run including various arrears statuses and balances.

Figure 1: How Vector works



Use Cases and Accuracy

The model was developed by Kensington's credit team over the last 10 years using Kensington's rich database of historical performance points for the UK mortgage market across multiple credit cycles. This historical database is rare in the UK, unlike the US where significant amounts of performance data is publicly available. It has been used to forecast the expected portfolio performance for over 800,000 UK loans, with proven accuracy and where necessary, has been calibrated to better reflect the historical experience of the originator(s) of each portfolio.

As an example, between 2015 and 2016, Kensington was involved in the acquisition of 2 large mortgage portfolios (totalling c. £6bn and over 60,000 loans) from GE Capital. Vector was used to forecast the portfolios' performance through time in December 2016. The results in figure 2 demonstrate that the model was able to predict the future balance and arrears profile of these 2 portfolios to a high degree of accuracy. This allows for correct gauging of the economics of the portfolios' funding structure, which is particularly useful where the structure has triggers linked to asset performance metrics such as arrears.

Figure 2: Vector Forecasts vs. Actual

	June 2015 (Actual)	June 2018 (Forecast)	June 2018 (Actual)
Balance	£6.3bn	£4.49bn	£4.44bn
3MIA+ Arrears	1.4%	4.5%	4.8%
7MIA+ Arrears	0.4%	2.1%	2.3%

Similarly, as can be seen in figure 3, the model was able to forecast the redemption profile of the portfolios. CPR is a difficult metric to predict due to significant differences in profiles of seasoned

loans vs. newly originated loans. The model also captured the propensity of a loan moving from being current to being in arrears correctly.

Fig 3: CPR Forecast as at Dec-16 vs. Actual CPR

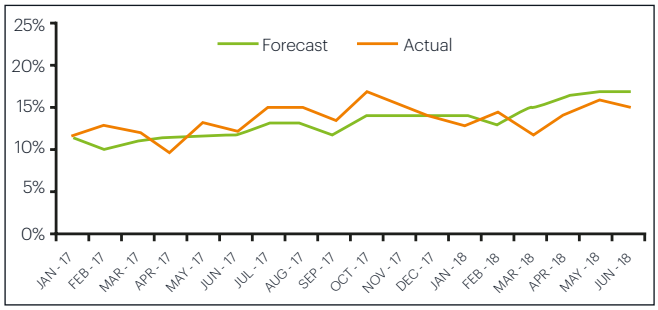
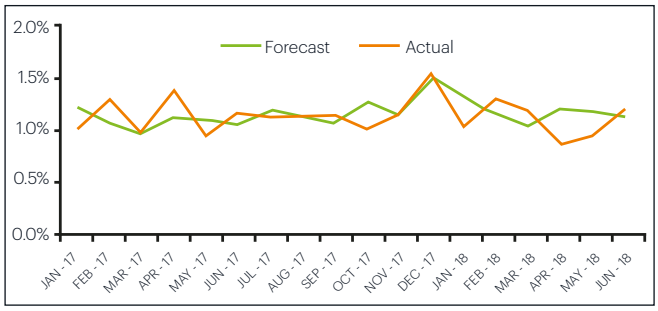


Fig 4: Roll Rate from 0 to 1 Forecast as at Dec-16 vs Actual



All of this is important not only to assess the economics of the portfolio, but also from a servicing perspective, as staffing levels can be estimated based on expected arrears levels, allowing a servicer (in this case Kensington) to plan for the correct staff levels through time. Importantly, a portfolio can be stress tested against any downside macroeconomic scenario to see the relative impact of such changes and the necessary adjustments including to staffing levels.

Brexit Scenarios

As seen, a robust forecasting model has many uses for mortgage lenders, servicers, and investors in mortgage portfolios. In times of economic uncertainty, these uses become almost indispensable. Driven by Brexit, the UK has been facing an uncertain macroeconomic future for some time, and firms need to be able to prepare for any of the possible outcomes. A model like Vector allows for the performance of an individual portfolio (e.g. in the case of an investor) or all of a firm's assets under management (e.g. for a servicer) to be modelled in various stress scenarios. To demonstrate the different ways this can play out, analysis has been conducted on 3 possible Brexit scenarios (described in Figure 5) for a portfolio consisting of Kensington's new originations as well as a portfolio of Kensington's legacy originations.

Figure 6: Collateral Stratification

WA by Current Balance (Dec-18)	Kensington Legacy	Kensington new originations
Outstanding Balance	£1.4bn	£1.9bn
No. of Loans	17,315	11,988
Average Current Balance	£80,289	£154,787
WAC	5.38%	3.91%
WA Original LTV	77.73%	74.18%
WA Current Indexed LTV	55.47%	69.42%
WA Seasoning (mths)	153.26	18.49
London & South-East	38.18%	42.47%
First Lien	96.41%	100.00%
Performing	75.53%	96.92%
30+ Arrears	24.47%	3.08%
90+ Arrears	14.01%	0.99%
LIBOR Index	21.59%	100.00%
SVR	77.35%	0.00%
Interest Only	72.22%	21.49%
Self-certified	68.38%	0.00%
Self-employed	49.12%	44.45%
CCJs	24.76%	9.70%
BTL	5.41%	18.00%

As can be seen in the following charts, in the BOE's stress scenario, defaults increase across all mortgage loans, due to a sharp increase of unemployment and interest rates and sharp decrease in HPI. On the legacy book, there is an initial CPR spike driven by the early repayment of legacy borrowers with low LTV. Then the CPR remains muted as the BOE stress assumes an initial drop in HPI with no significant recovery over the following 5 years. In this scenario, arrears on the legacy book also decrease as more loans exit the portfolio through the repossession process. This is not the case in the new origination portfolio as arrears are very low to begin with, hence they increase, but not enough to default.

In the Hard and Soft Brexit scenarios, defaults also rise on the legacy book due to a rise in unemployment. Given the lower indexed LTV of this book, the CPR remains higher in these scenarios as late stage arrears borrowers prepay to avoid repossession. However, for new origination loans this is reversed in the Hard Brexit scenario: the decline in house prices and the reduction of interest rates (given assumption of substantial QE) by the BOE make it less attractive for borrowers to refinance on reversion, hence the CPR falls in comparison to the Stress scenario. However defaults are moderate given that interest rates remain very low. This doesn't offset the rise in defaults in the legacy book.

Figure 5: Macro-economic scenarios

Scenarios	BOE Downside scenario	Soft Brexit	Hard Brexit
Description	• As provided by the BOE in March 2018 for the regulatory stress testing of the UK banking system • No specific assumption for Brexit	• Goods and Services: Access to the EU market with EU laws (excl. food and drinks) • People: Free movement of EU people • Contribution to EU budget (but no vote) • Remains in the customs union	• Goods and Services: Specific FTA (excl. financial services) • People: Full control over immigration with hard Ireland – Northern Ireland border • No contribution to EU budget • FTAs with third countries
Interest rates	Jump to 4.85% in Y1	+50bps p.a.	Decrease to 65bps in Y1 and remaining low
House Prices	Down 33% from Y1 to Y3	Y1-Y3: up 2% p.a. Y4+: up ~3-5% p.a.	Y1-Y3: Flat Y4+: up ~3-5% p.a.
Unemployment	Jump to 9.5% in Y1	Flat @~4.8%	Increase to 6% from Y1 to Y3

Fig 7: CPR Kensington Legacy

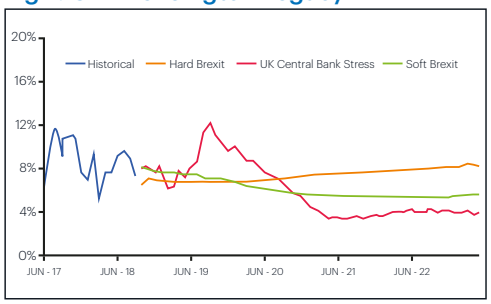


Fig 8: CPR Kensington New Originations

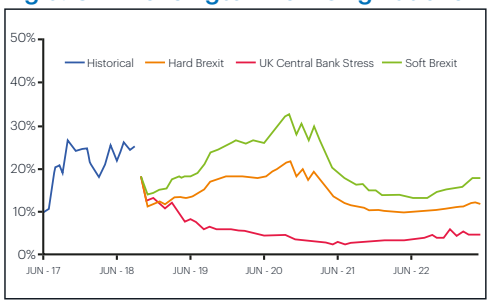


Fig 9: Defaults Kensington Legacy

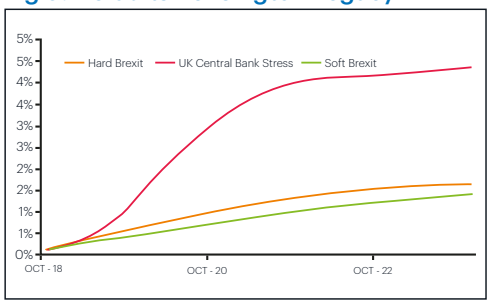


Fig 10: Defaults Kensington New Originations

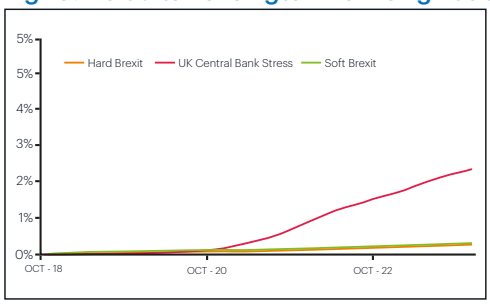


Fig 11: 30+ Arrears Kensington Legacy

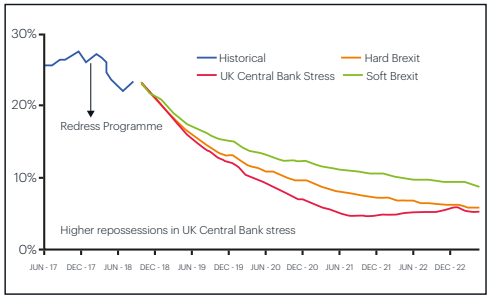
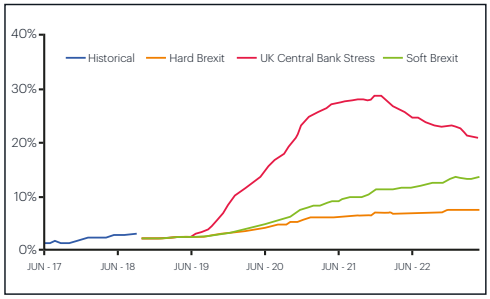


Fig 12: 30+ Arrears Kensington New Originations



Conclusion

While no loan forecasting model can help us establish which macroeconomic outlook is most likely, it can help us anticipate and thus prepare for any of the 3 (or even a range of other) outcomes. Clearly, the different scenarios demand different responses from market participants, regardless of the type of firm they are, demonstrating the extent to which a predictive versatile model such as Vector can be invaluable.

References

US mortgage market research is available here:
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https://openscholarship.wustl.edu/cgi/viewcontent.cgi?article=2093&context=art_sci_etds
https://bfi.uchicago.edu/sites/default/files/file_uploads/Slides%20Giesecke.pdf

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