GSJ: Volume 7, Issue 6, June 2019
ISSN 2320-9186

GSJ: Volume 7, Issue 6, June 2019, Online: ISSN 2320-9186

www.globalscientificjournal.com

ANALYSIS OF BANK MIGRATION OF CREDIT RISK USING TRANSITION MATRICES

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ABSTRACT

Credit risk is one of the most critical areas of financial research of late. It is motivated by recent progress in risk management portfolio and techniques in management, trading in Credit growth derivatives, implementation of Basel II accord and concerns from regulators driven by credit crisis that occurred in the USA between 2001 and 2002. Within this vast literature, advances in research provides an analysis of the role, influence and meaning of the Credit ratings that merit Credit Risk. This paper analyses the links which are two way between Macroeconomic states and Credit risk assessment deciphered through business cycles phases. We propose a technique or methodology which can be applied in Banks data and is internally rated having project migration of ratings and their probabilities as well as integrating the economy state. We discuss first the matter on whether the risk of credit is low or high in diverse states of economy. In order to discuss these scenarios, we scrutinize each year having four quarters representing different states within the year. We then review how conservation of macroeconomic are integrated in models of Credit Risk and approaches in risk measurements having Basel II and Basel III as their core approach.

KEY WORDS

Credit Risk, Basel III, Matrix, Transition probability, CTML, DTML

INTRODUCTION

The Basel committee on Bankng supervision(BCBS 2000, pg2) defines Credit risk as the tendency that a borrower from Bank or counterparty will dishonour the agreed terms his/her obligations. Normally associated with income generating securities and loans hence it is the main bank revenue source. Credit risk in banking are increasing in different financial facilities that are not necessarily loans including transactions which are interbank, bonds, swaps, trade financing, equities and foreign exchange transactions. Under the guidelines of Basel and Basel III, Banks are permitted to utilize their customised parameters of projected risk for the aim of evaluating regulatory capital also referred as Internal Ratings Based (IRB) method to Credit risk capital requirements. Banks satisfy specific minimum conditions, requirements of disclosure and their national regulator approval were permitted to utilize this method in projection capital for exposures to various risk (BCBS 2004). The IRB method depends on a Bank's customised own evaluation of its exposures and counterparties so as to compute the credit risk capital requirements. Hence it is sufficient to innovate a method to precisely project migration probabilities credit rating. This concept depends on the incremental Risk Charge (IRC) which the regulator came up with (BCBS 2009) making it mandatory for Banks to evaluate a one year 99.9% VaR (Value at Risk) for Bank assets that made losses in the books of trade. Banks are mandated to provide changes in ratings and also defaults.

Hence ultimately with the subjected instruments to the IRC, it is taken that a Bank has chance to readjust its portfolio within the year in order to mitigate its default risk. Changes in the lender's rating risk is shown by analysis of migration or the system of credit scoring which is a measurement that is probability based for Credit risk. This method provdes for upgrades and downgrades in quality of the credit of a loan portfolio entirely as well as the loan default and financial stress potential (Altman and Saunders 1998).

From the capital market turmoil experienced recently, there's a sharp increase in negative rating numbers and rating agencies leading to actions indicating deterioration in firms quality of Credit brought by harsh conditions of economy. These quality of Credit dynamics which is a core part of solution to credit riskin modern times (Tsaig et al 2011). A number of recent studies have differentiated economic activities which ar real into regimes or phases which are separate. In their method, contradictions are separated from boons in order to evaluate the observation of the model parameters utilized by scrutinizing the weighted impact of phases each on parameters. For example, thids is applied to interest dynamics of empirical research done initially (Hamilton 1988 and cecchetti et al 1990) or (Engel 1988 and Hamilton 1990) who did exchange rates and (Hamilton and Susmel 199) who explored dynamics conditional variance of stock returns. Migration behaviour Credit rating most recently has been done by (bangla et al 2002), belkin et al (1998) and Kim (1999) who have utilized a model which is one factor and ratings give response to shifts in business cycles. The main objective of this paper is to provide a model of probabilities of migration of the Credit ratings which takes into consideration both the economic state cycle and rating data from IRB. Once of the model parameters and data have been gathered, evaluation is made possible to gauge its fitness and how it suits the data. Its evaluation is got through values of parameters which suits the data best. Techniques of parameter estimation are generally two i.e Least Squares Estimation Method (LSE) and the Maximum Likelihood Estimation (MLE).

METHODOLOGY

Utilizing time homogeneity in estimating transition probabilities from a sample of pairs numbering 185000 observations, we can estimate a transition matrix which is one quarter after the likelihood function is maximized. The log-likelihood function is given by;

$$lnl\left(P_{quarter}\right) = \sum_{i=1}^{n} \sum_{j=1}^{j_{i-1}} \left(t_{ij+1} - t_{ij}\right) lnp_{\pi}$$

The total likelihood function results from the contribution over firm i:

$$l_i P_{quarter} = \prod_{j=0}^{j_i - 1} P_{ll'}^{(t_{ij}+1-t_{ij}}$$

Where $\pi = P_{quarter}(l, l')$

Attention is disregarded whether firm i is at default state at the period end.

The equation can be rewritten as;

$$L(P_{quarter}) = \prod_{i=1}^{n} \prod_{j=0}^{j_i-1} P_{ll'}^{(t_{ij+1}-t_{ij})}$$

Hence the log likelihood function results in equation below;

$$\ln L(P_{quarter}) = \sum_{i=1}^{n} \sum_{j=0}^{j_i-1} (t_{ij+1} - t_{ij}) ln \quad _{ll'}$$

Non-parametric bootstrap can be used to obtain standard errors and has three steps.(Rolski et all 2009).

1) Using the data set, provide the population estimation.
2) From the population distribution, provide a simulation from the sampling that resulted the observations set $\{xi\}$.
3) Evaluate the sample statistic you are interested in from each sampling.

The frequency distribution is set for the non-parametric boot strap from the n data values which is the population distribution or probability distribution. Jaffry and Schuermann (2004) considered a criteria set by which a proposed metric performance known as singular value of decomposition metric M_{SVD} wll be evaluated. Distribution discrimination is one of the vital requirements i.e a discrimination between identical diagonal probabilities matrices should be provided by the metric with off diagonal distributions which are different. According to Mahlmann(2006), such a difference between matrices having same mobility amount is of great importance in Credit risk context since migrations which are far possess diverse financial and economic consequences than migrations which are near. Jaffry and Schuermann (2009) proposed a metric which provided a transition probability matrix P transformation of $I_D \times I_D$ dimension as;

$$M_{SVD}(P) = \frac{\sum_{i=1}^{n} \sqrt{\lambda_i (I-P)'(I-P)}}{I_D}$$

Where I and $\lambda_j(G)$ is the same identity matrix and points to the $I_D \times I_D$ matrix G eigen value.

RESULTS

When searching the starting value which is optimum for the process respectively, the likelihood function was used initially but resulted being flat. It was evaluated upto the fourth level of the estimation of a 1-year cohort together with the average 1-year and estimated matrix of one quarter. It resulted eventually as the estimator cohort starting value which was the solution i.e optimum solution. As a result from the assumptions which were time homogeneous, the pairs observed of a period which was four-quarter were utilized for the observation which was 1-year. An allowance of observations which overlapped is also admissible. A transition probability matrix which is 1-year is got by evaluating the transition matrix which is one quarter to the fourth power and the estimations of DTML as well as the 1-year cohort shown in the table below.

Table 1: Comparison of estimated methods of average transition probabilities which are time homogeneous

From	To					Def
	Part A: The transition matrix one year cohort					
	1	2	3	4	5	
1.	0.9612	0.0182	0.0054	0.00711	0.00004	0.00000
	(0.00174)	(0.00151)	(0.00053)	(0.00022)	(0.00007)	(0.00000)
2.	0.1273	0.93780	0.03724	0.01021	0.00158	0.00035
	(0.00094)	(0.00217)	(0.00193)	(0.00080)	(0.00036)	(0.00011)
3.	0.00025	0.00410	0.95198	0.03924	0.00393	0.00050
	(0.00005)	(0.00020)	(0.00084)	(0.00072)	(0.00028)	(0.00004)
4.	0.00025	0.00070	0.02381	0.95480	0.01662	0.00380
	(0.00004)	(0.00010)	(0.00056)	(0.00075)	(0.00041)	(0.00028)
5.	0.00021	0.00005	0.00481	0.051219	0.92451	0.01919
	(0.00013)	(0.00003)	(0.00053)	(0.00239)	(0.00279)	(0.001550
Def	0.0000	0.0000	0.0000	0.0000	0.0000	010000
	PART B: The transition matrix discrete time of 1-year.					
1.	0.94046	0.04671	0.00834	0.00387	0.00024	0.00040
	(0.00284)	(0.00272)	(0.00082)	(0.00051)	(0.00020)	(0.00028)
2.	0.03065	0.85442	0.08178	0.02992	0.00284	0.00037
	(0.00189)	(0.00292)	(0.00240)	(0.00192)	(0.00040)	(0.00138)
3.	0.00123	0.01981	0.87609	0.09554	0.00612	0.00121
	(0.00018)	(0.00043)	(0.00151)	(0.00122)	(0.00024)	(0.00016)
4.	0.00068	0.00260	0.07212	0.87705	0.04121	0/00634
	(0.00008)	(0.00001)	(0.00085)	(0.00248)	(0.00083)	(0.00017)
5.	0.00053	0.00055	0.01884	0.1330	0.78440	0.06240
	(0.00027)	(0.00026)	(0.00074)	(0.00421)	(0.00468)	(0.00389)
Def	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

CONCLUSION

Given that financial strength regulating conditions or measures for example Capital ratio of tier I are given as Capital which is core to risk measured or weighted assets, the way to approach in order to evaluate Credit transition or or migration risk is a vital determinant of Capital outlay that banks should hold as a measure to curb losses. This paper provides the literature by scrutinizing the link between macro economy and management of Credit risk. After utilizing for our macroeconomic variable the CUI, a quotient of the true output level to the capacity was based on the study from data originating from Banks internal rating system of Kenyan Banks. This study evaluates empirically the average matrices which are time homogeneous in order to estimate the dependence on time and provide differences between CTML and DTML approximations. The DTML method was applied to four cycles of different business scenarios i.e average, contraction, mixed period and boom and was found that the fuction which is time independent provides an overestimation at the boom scenario of the PDs hence providing room for future research.

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