

Original article

Modelling tail credit risk using transition matrices

D.E. Allen, A.R. Kramadibrata, R.J. Powell*, A.K. Singh

School of Accounting, Finance and Economics, Edith Cowan University, Australia

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Abstract

Innovative transition matrix techniques are used to compare extreme credit risk for Australian and US companies both prior to and during the global financial crisis (GFC). Transition matrix methodology is traditionally used to measure Value at Risk (VaR), a measure of risk below a specified threshold. We use it to measure Conditional Value at Risk (CVaR) which is the risk beyond VaR. We find significant differences in VaR and CVaR measurements in both the US and the Australian markets. We also find a greater differential between VaR and CVaR for the US as compared to Australia, reflecting the more extreme credit risk that was experienced in the US during the GFC. Traditional transition matrix methodology assumes that all borrowers of the same credit rating transition equally, whereas we incorporate an adjustment based on industry share price fluctuations to allow for unequal transition among industries. Our revised model shows greater change between Pre-GFC and GFC total credit risk than the traditional model, meaning that those industries that were riskiest during the GFC are not the same industries that were riskiest Pre-GFC. Overall, our analysis finds that our innovative modelling techniques are better able to account for the impact of extreme risk circumstances and industry composition than traditional transition matrix techniques.

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1. Introduction

Extreme credit risk can have a devastating impact on financial institutions, economies and markets. It is therefore essential that extreme credit risk is accurately measured and understood. The GFC provided overwhelming evidence of the problems caused by poor credit risk management. The losses and increase in problem loans experienced by banks during the GFC is staggering. Over the 2 years to March 2009, impaired assets (problem loans) in the US more than trebled from 2.4% of total assets to 8.8%, an increase of USD 480 billion. The 5 largest US banks showed losses of nearly \$50 billion over the 2008 year. Australian bank impaired assets increased fivefold (although off a smaller base) from 0.2% to 0.95%, an increase of USD 24 billion [21]. The US Government needed to provide a \$700 billion Troubled Asset Relief Programme (TARP) to support banks. Australia introduced government deposit guarantees to shore up confidence in banks.

* Corresponding author at: School of Accounting, Finance and Economics, Edith Cowan University, 270 Joondalup Drive, Joondalup, 6027, Western Australia, Australia. Tel.: +61 863042439.

E-mail addresses: d.allen@ecu.edu.au (D.E. Allen), a.kramadibrata@ecu.edu.au (A.R. Kramadibrata), r.powell@ecu.edu.au (R.J. Powell), a.singh@ecu.edu.au (A.K. Singh).

Credit ratings have come under intense scrutiny during the GFC, mainly in respect to the understatement of the risk involved in mortgage backed securities and collateralised debt obligations, with the subsequent downgrade of the ratings of these products raising questions as to the accuracy of their initial ratings. Major banks and corporates around the world received ratings downgrades in the aftermath of the crisis. For example, all four major Australian banks were downgraded from AA to AA– in December 2011 by Standard & Poor’s [24] and several US banks received Moody’s [20] ratings downgrades in June 2012, including major banks such as Bank of America, Citigroup, Morgan Stanley, JP Morgan Chase and Goldman Sachs. Ratings downgrades have also been experienced by banks in several European countries. Sovereign ratings have also been under the spotlight. Whilst Australia has retained their AAA sovereign rating, the US sovereign rating was downgraded from AAA to AA+ in 2011. The European sovereign debt crisis has led to many European countries (such as Austria, France, Greece, Italy, Portugal and Spain, among others) receiving one or more downgrades during 2011 and 2012. Other European countries had their outlook changed from positive to negative, including Germany, Netherlands and Luxembourg, among others. There has been a link between sovereign and bank ratings in many instances. For example Moody’s downgraded the outlook of 17 German Banks following their decision to change Germany’s outlook and downgraded the ratings for 13 Italian Banks following their downgrading of Italy’s government bond rating. These events have led the European Central Bank [15] to call for a banking union as an integral part of the European monetary union, involving policy measures such as: strengthening of the Euro area-wide supervision of the banking sector; breaking links between banks and sovereigns to reduce the impact of financial disturbances within a sovereign area on the banking sector; the establishment of European deposit guarantee scheme and resolution arrangements; and minimising risks for taxpayers by ensuring adequate contributions by the financial industry.

In short, the subject of credit risk in extreme circumstances has become an intensely scrutinised topic in finance today. Yet, to date it has been poorly modelled and understood. According to all the widely used credit models, the GFC was not supposed to happen, because none of these models predicted the problem. In fact, the credit ratings of all major Australian banks were increased just before the GFC from AA– to AA on the basis of their sound credit risk outlook. Yet over the next 2 years, in addition to the five-fold increase in impaired assets, Australian banks’ market capitalisation plunged by 58%. Prevailing credit models were generally designed to predict credit risk on the basis of ‘average’ credit risks over time, or, in the case of Value at Risk (VaR) models on the basis of risks falling below a pre-determined threshold at a selected level of confidence, such as 95% or 99%. The problem with these models is that they are not designed to measure the most extreme losses, that is, those in the tail of the credit loss distribution. It is precisely during these extreme circumstances when firms are most likely to fail.

Transition matrix methodology, as used most notably by CreditMetrics [16], measures the probability of transitioning from one credit rating to another, and uses these probabilities to calculate VaR. Examples of other studies of ratings based modelling or transition matrices that can be referred to include bond pricing aspects [17,18,26], time or business cycle sensitivity [4,12,27], discussion of the transition modelling approach [13,22], and fixed interest credit spreads in Australia [11]. We extend CreditMetrics methodology to calculate Conditional Value at Risk (CVaR) which measures extreme risk beyond VaR, thus addressing VaR’s shortcoming in its lack of tail risk measurement. CVaR was traditionally used in the insurance industry but has gained popularity as a measure of market and credit risk. For examples of CVaR studies see Artzner, Delbaen, Eber and Heath [6,7], Bucay and Rosen [10] and Andersson, Mausser, Rosen and Uryasev [5].

CreditPortfolioView [28] extends CreditMetrics methodology to incorporate industry risk, using macroeconomic factors, thus recognising not all industries transition equally. This phenomenon was illustrated over the GFC where, for example, the financial industry experienced more severe problems than other industries. However, macroeconomic approaches to industry risk measurement are not always popular as noted by the Australian Prudential Regulation Authority [APRA 8, p. 4] in their statement “Currently none of the Australian banks favours a credit risk modelling approach conditioned on the state of the economy. Apart from the additional modelling complexity involved, the banks express concern that errors in forecasting economic turning points could lead, in particular, to a shortfall in desired capital coverage just as the economy turns sharply downwards”. Based on the premise that all risks inherent in an industry should already be captured in market prices and VaR, we use a transition matrix (which we call *i*Transition) incorporating industry risk factors derived from equity price fluctuations, without the need for macroeconomic analysis.

The innovative techniques discussed in this paper were first introduced by us prior to the GFC to compare credit risk among Australian sectors [2]. This study now extends their application to compare Australia and the US over both Pre-GFC and GFC periods, using a dataset which includes more than six hundred companies. The motivation for

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