ProMS®

Calibrating IPRE Risk Models Using 1990s Loss Histories

Radley &
Associates

Radley & Associates is an independent firm dedicated to the development of advanced simulation based analytics for the Commercial Real Estate industry. Our clients include leading banks, fund managers and REITS. We have deep expertise in property, simulation modelling, econometric analysis and risk.

RADLEY & ASSOCIATES
2 Nottingham Street
London
W1U 5EF
0207 224 3079

Calibrating IPRE Risk Models Using 1990s Loss Histories

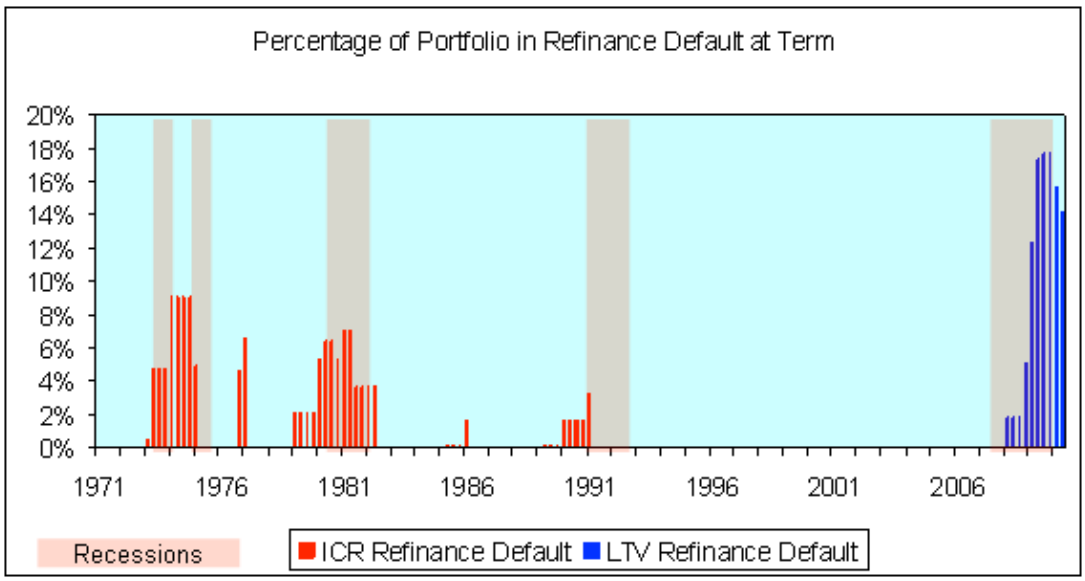
Introduction

This article asks the question: *what is the effect of using 1990s loss histories for calibrating IPRE risk models for the 2010s?* We examine the effect of historical changes in market rents, collateral values and interest rates on loan origination terms and their subsequent impact on IPRE loan defaults

Summary findings

From the 1970s to the recession of 1991/92, high interest rates limited the loan amounts advanced to IPRE borrowers at the point of loan origination. Loan to Value ratios (LTVs) were typically in the 40% – 60% region for most of this period. During the 1991/92 recession neither ICRs nor the LTVs of the previous decade's loan cohorts were sufficiently damaged to present significant refinance default. However, after 1992, interest rates fell and have remained low. No longer contained by ICR constraints at origination, lenders reviewed guidelines and loan levels rose to near the 80% LTV level and stayed there for over a decade.

The loan cohorts that were originated in this period were thus more vulnerable to collateral value deterioration during the 2008/10 recession and have displayed very high levels of refinance default, despite the relief they enjoyed to their debt servicing from steep falls to historically low interest rates.



Using loan cohort analysis and empirical data, the estimated refinance default rate in the 2008/10 recession is more than twenty-two times higher than the refinance default rate during the 1991/92 recession. Thus, using 1990s default experience to calibrate IPRE risk models runs the risk of underestimating future refinance defaults by at least an order of magnitude.

Background

Banks and regulators are keen to develop risk models for IPRE lending and are increasingly looking to the experience of loan losses in this asset class during the last recession (91/92) as well as the recent recession (08/10) to help calibrate them. This article seeks to assess the relevance of IPRE loan loss histories in previous recessions and 91/92 in particular to an understanding of models to predict future loan losses. Does the experience of 91/92 help us build reliable and conservative models?

Development loans, buy to let, social housing, full recourse lending and other commercial property lending types have different risk characteristics and are excluded from the scope of this analysis.

Recent UK recessions

Since reliable records for commercial property values and rents have been collected in the UK (c 1970), there have been 5 recessions. The definition of recession we are using is two consecutive quarters of negative annual growth. The severity, duration and time between recessions are varied.

Exhibit 1: UK Recessions

UK Recessions post 1970	*GDP contraction start to finish*	*No of quarters in recession*	*No of quarters between recessions*
1974	-3.4%	2	
1975	-2.7%	3	4
1980-81	-5.9%	6	18
1991-92	-2.5%	7	37
2008-10	-6.4%	7	65

The 2008/10 recession has been about twice as long coming, but more than twice as severe as the 1991/92 recession in terms of GDP contraction. Taking the 1974 and 1975 recessions as a single recession, the severity of the 1991/92 recession stands out as being less than half as severe as the others.

Tenant and Refinance Default

To help assess the effect of recessions on defaults and losses, the following analysis separates IPRE loan risk into two categories; tenant default and refinance default. Broadly speaking, IPRE tenant related defaults can be expected to be correlated to changes in the default rates of UK companies as they fluctuate through the economic cycle as well as loan specific factors such as lease structures and break dates. Refinance defaults (sometimes referred to as market risk) are defined by BIPRU as events where an IPRE loan, *at term*, can not be refinanced on broadly similar terms by another lender. To examine refinance default, the analysis uses two simple criteria. A refinance default occurs if, at term, a loan has:

A An LTV **>** than an agreed LTV hurdle, (LTVmax)

OR

B An ICR **<** than an agreed ICR hurdle, (ICRmin)

Tenant Default

The economic cycle has an effect on the absolute level of tenant default rate, which in turn affects IPRE loan default rates. The measure of tenant default examined here is defined as the number of UK defaulting companies in each year over the number of registered companies each year (the data is available from 1980 onwards: see sources below).

Exhibit 2: UK Bankruptcy Rates

UK Recessions post 1970	*Increase in UK bankruptcy index(*)*	*Max. level of Bankruptcy rate*
1974		
1975		
1980-81	86%	1.02%
1991-92	49%	1.56%
2008-10	27%	0.98%*

In terms of the absolute bankruptcy rate, as well its increase from the start of the recession to its peak following the recession, the 2008/10 recession has been mild by historic standards. This may perhaps be attributed to the economic stimulation and quantitative easing programmes of the then government. Low interest rates may also have played a part.

In terms of tenant risk, the 2008-10 recession may prove to have a smaller impact than that of the 1991/92 recession. For calibration purposes, lenders may consider *reducing* their downturn multiples for this type of risk.

Refinance risk (ICR default)

The probability of this type of refinance default depends on the ICR of a loan at its origination and the subsequent migration of its ICR to the point of refinance at term. The main cyclical factors that affect ICR migration over time are interest rates and market rents (ERVs).

Though much of IPRE lending in today's markets is hedged with interest rate swaps, these swaps are normally coterminous with the loan, so loan refinancing will be dependent at the prevailing interest rates at term whether hedged or not.

* Increase in bankruptcy rate from start of recession to peak following recession

Exhibit 3: Three Month LIBOR

UK Recessions post 1970	LIBOR at start of recession	LIBOR at end of recession	Change in LIBOR during recesssion	LIBOR 3 years after recession	Change in LIBOR after recession
1974	12.0%	12.0%	0.0%	11.3%	-0.7%
1975	10.7%	10.7%	0.0%	9.3%	-1.4%
1980-81	16.6%	13.9%	-2.8%	9.8%	-4.1%
1991-92	14.3%	10.5%	-3.8%	6.2%	-4.3%
2008-10	5.5%	0.8%	-4.7%	?	?

Short-term interest rates typically fall during recessions and continue to fall in the three year period thereafter, reducing the debt service pressure and default rates on refinancing loans. The recessions of 1974 and 1975 were more inflationary than subsequent recessions, so short term interest rates did not fall (though they did fall slightly if viewed as a single recessionary period).

The interesting comparison between the 1991/92 and the 2008/10 recessions is the absolute level of interest rates at the *beginning* of the recession since these rates effect the loan terms of the cohorts entering the recession. The 2008/10 recession began with interest rates at historic lows, at less than 40% of the interest rates prevailing prior to the 1991/92 recession.

In the three years following 1992, interest rates fell by 4.3%, taking a considerable burden off IPRE debt servicing. In 2010, interest rates, having fallen to almost zero, have no chance of declining further and a significant chance of rising.

Exhibit 4 Rents

UK Recessions post 1970	ERV change from peak before recession	ERV 3 years after recession
1974	10%	19%
1975	-2%	17%
1980-81	12%	11%
1991-92	-8%	-15%
2008-10	-10%	?

Rents were stable or rising throughout the more inflationary, pre-91/92 recessions and in the subsequent three year aftermaths. The recessions of 91/92 and 08/10 saw rents fall by a maximum of 8% and 10% from the peak before the recession. In the three year period following the 91/92 recession, rents fell a further 15%.

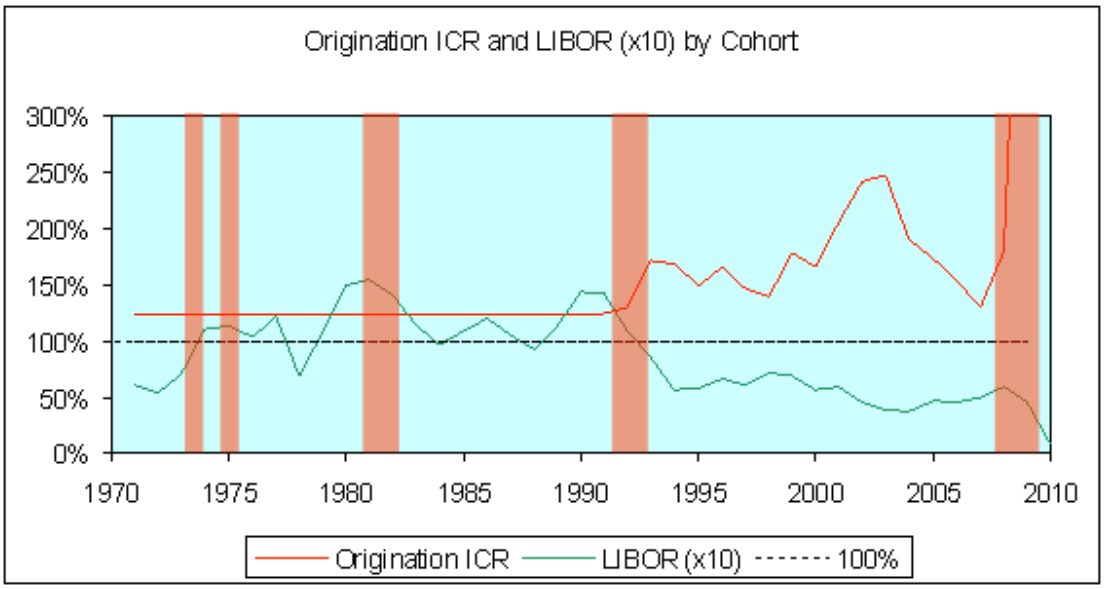
Origination ICRs

Approximate ICRs at origination for each cohort can be calculated using historic values for rent levels, LIBOR, and yields, and by assuming:

- a lending margin of 1% above LIBOR,
- a loan policy ICR minimum of 125% and
- a loan policy maximum LTV of 80%,
- typical amortisation of 1.7%p.a.[†]

This analysis assumes that loans are always originated at the maximum allowable level (the loan amount being bound either by lender's maximum LTV or minimum ICR criteria): a conservative approach, suitable for the purposes of model calibration. (See *Appendix: Cohort Model Specification* for details).

Exhibit 5: Origination ICRs and Interest Rates



The analysis shows that up to 1992, high interest rates prevailed and minimum interest cover ratios were binding at the point of origination. Only after interest rates fell in the 1990s did origination ICRs rise (as LTV criteria became binding). ICRs of cohorts originated before the 1991/92 recession were typically at 125% (or the prevailing minima) and these rose in the decade preceding the 08/10 recession to the 150% to 250% range. By tracking the effect of changes in market rents and interest rates on each loan cohort's ICR through each recession, the impact on refinance default can be estimated.

[†] Source DeMontfort University report 2009

Exhibit 6: ICRs during recessions for each cohort

ICRs by Cohort and Recessionary Quarter

Cohort	1991Q1	1991Q2	1991Q3	1991Q4	1992Q1	1992Q2
	Recessionary Quarters					
1981	274%	288%	307%	322%	333%	336%
1982	235%	247%	263%	276%	285%	288%
1983	192%	201%	215%	225%	233%	235%
1984	181%	190%	203%	213%	220%	222%
1985	206%	216%	230%	242%	249%	252%
1986	169%	177%	189%	199%	205%	207%
1987	131%	138%	147%	154%	159%	161%
1988	113%	118%	126%	132%	137%	138%
1989	127%	134%	143%	150%	155%	156%
1990	129%	135%	144%	151%	156%	157%

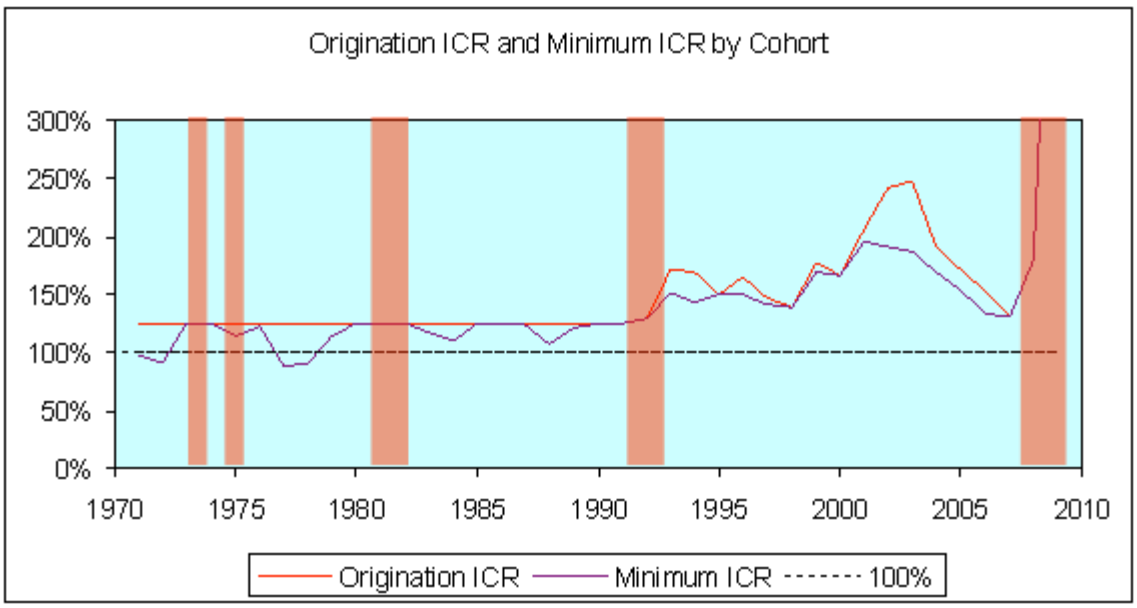
Cohort	2008Q3	2008Q4	2009Q1	2009Q2	2009Q3	2009Q4	2010Q1
1998	217%	230%	264%	321%	434%	622%	738%
1999	204%	216%	248%	302%	408%	586%	695%
2000	198%	210%	241%	293%	396%	569%	674%
2001	199%	211%	242%	295%	399%	572%	678%
2002	195%	207%	237%	289%	391%	561%	665%
2003	190%	202%	232%	282%	382%	547%	649%
2004	173%	184%	211%	257%	347%	498%	590%
2005	156%	166%	191%	232%	313%	450%	533%
2006	136%	145%	166%	202%	273%	392%	464%
2007	133%	141%	162%	197%	266%	382%	453%

In the 1991/92 recession, loans originated in 1988 would be in danger of refinance default as their ICRs deteriorated to 113% or 118%. However, falling interest rates during the recession lessened this pressure and most cohorts would not have presented any risk of refinance default during the rest of the recession.

The risk of interest cover related refinance default in the 2008/10 recession is even lower. Even the 2007 cohort has improving ICRs and the rapid fall in interest rates removed the pressure from this type of refinance risk altogether by the end of the recession. The average backbook ICR of 336% in the 08/10 recession compares favourably with the average ICR (again for the previous decade's cohorts) of 199% for the 91/92 recession.

Although it should be noted that a small rise in interest rates in 2011 or 2012 could put significant stress on the ICRs of existing loans, this study examines only historic data.

Exhibit 7: Origination ICR and Lifetime Minimum ICR by Cohort



None of the cohorts originated in the decade before 2008 have (yet) seen a deterioration of their ICRs to the point that they present a danger of causing refinance defaults. The cohorts originated prior to 1991/92 were considerably closer to posing a refinance risk. Previous cohorts, originated in the 1970s, did show significant deterioration – even to the probable point of non-performance, especially following the 1975 recession.

Refinance risk (LTV default)

In a similar manner to origination ICRs, the origination LTVs of each loan cohort and their subsequent trajectories, driven by market changes in CRE capital values, have an effect on LTV type refinance defaults.

Exhibit 8: IPD UK All Property Capital Value Index

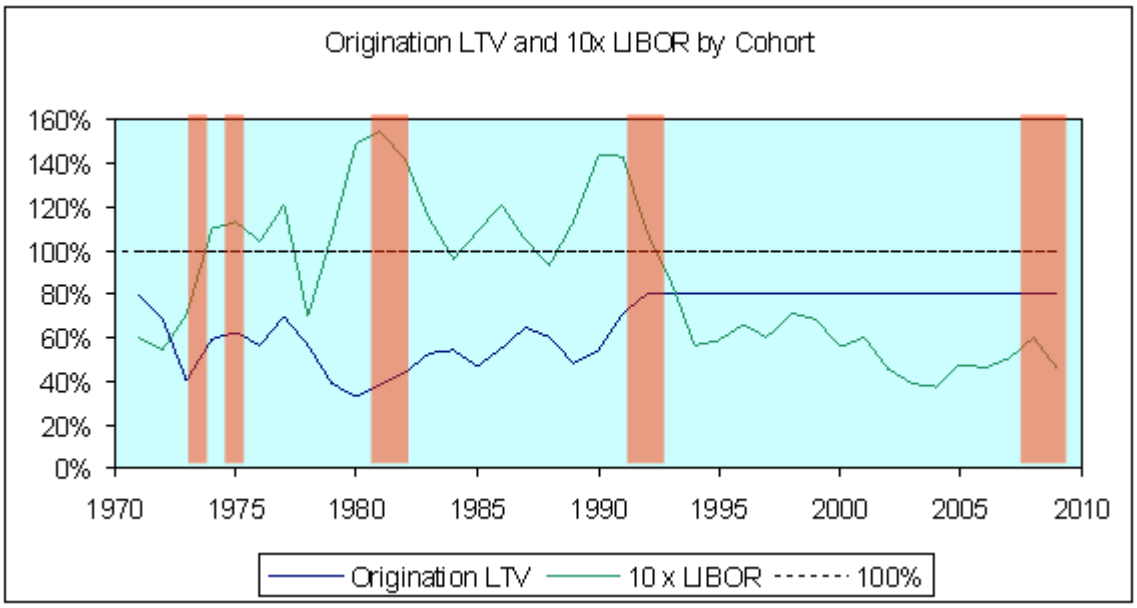
UK Recessions post 1970	*CV change from peak before recession*	*CV 3 years after recession*
1974	-9%	3%
1975	5%	46%
1980-81	13%	7%
1991-92	-22%	4%
2008-10	-42%	?

In most cases, capital values actually rose during or after the pre-91/92 recessions. But the 1991/92 recession was similar to the 2008/10 recession in that both have seen sharp falls in Capital Values. (The subsequent recovery, to date, of the current recession is about 10%).

Origination LTVs

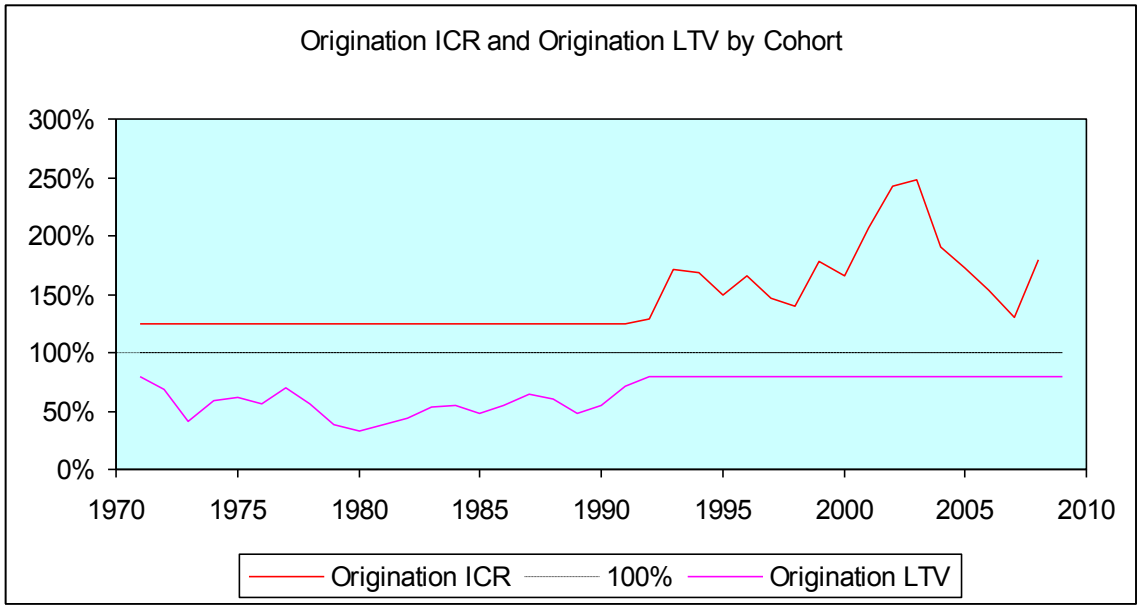
Again, cohort analysis (see Appendix) was used to calculate the origination LTVs for each loan cohort.

Exhibit 9: Origination LTVs



This analysis shows that before 1992, because of high interest rates, origination LTVs were considerably lower than 80% - mostly in the region of 40%-60%. Lenders were constrained by their minimum ICR policies from offering higher LTVs. As a result, *the LTVs of cohorts of loans approaching the 1991/92 recession were significantly lower than those approaching the 2010 recession.*

Exhibit 10: Comparison of Origination ICRs and LTVs



A comparison of origination ICRs and LTVs shows that there was a shift in 1992 from binding ICRs to binding LTVs.

The analysis results are supported by the DeMontfort University data for the period 1999-2006, where LTV ratios for the period were consistently within a band of 76% - 82%.

Exhibit 11: LTVs during recessions for each cohort

	Recessionary Quarters					
Cohort	1991Q1	1991Q2	1991Q3	1991Q4	1992Q1	1992Q2
1981	26%	27%	27%	28%	28%	29%
1982	31%	31%	32%	32%	33%	33%
1983	38%	38%	39%	39%	40%	41%
1984	40%	41%	41%	42%	43%	43%
1985	35%	36%	37%	37%	37%	38%
1986	43%	44%	44%	45%	46%	46%
1987	55%	56%	57%	58%	59%	60%
1988	64%	65%	67%	67%	68%	70%
1989	57%	58%	59%	59%	60%	61%
1990	56%	57%	58%	59%	60%	61%

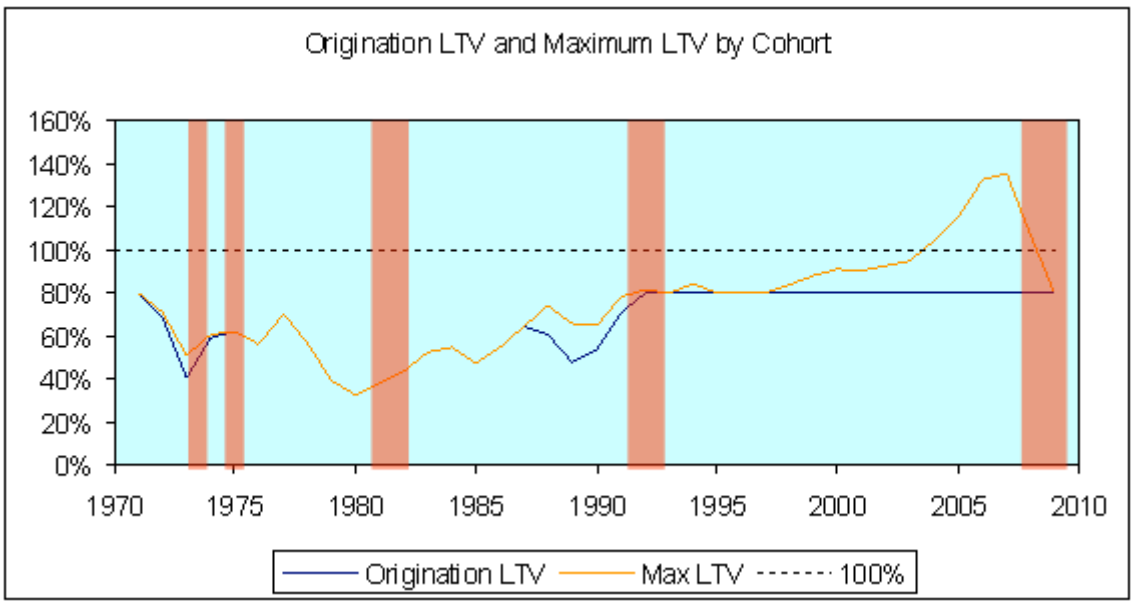
	Recessionary Quarters						
Cohort	2008Q3	2008Q4	2009Q1	2009Q2	2009Q3	2009Q4	2010Q1
1998	59%	63%	73%	80%	83%	82%	76%
1999	62%	66%	78%	85%	88%	87%	81%
2000	64%	68%	80%	88%	91%	90%	83%
2001	64%	68%	79%	87%	91%	89%	83%
2002	65%	69%	81%	89%	93%	91%	84%
2003	67%	71%	83%	91%	95%	93%	86%
2004	73%	78%	91%	100%	104%	103%	95%
2005	81%	87%	101%	111%	115%	114%	105%
2006	93%	99%	116%	127%	132%	130%	121%
2007	96%	102%	119%	130%	136%	134%	124%

Because loan cohorts originated in the decade before the 2008/10 recession were all originated at maximum levels close to 80% LTV, the collapse in collateral values at the start of the recession left LTVs at significantly higher levels, ensuring high levels of potential refinance defaults for loans terminating during the period of the recession.

By contrast, the cohorts written in the decade preceding the 1991/92 recession never suffered from sufficient collateral value deterioration to put them at risk of refinance default of the LTV type. At worst, the 1988 cohort, was approaching the 80% LTV by Q2 1992.

The average LTV of all cohorts across the 2008/10 recession was 91% almost exactly twice the equivalent level (46%) for the 1991/92 recession.

Exhibit 12: Origination LTV and Lifetime Maximum LTV by Cohort



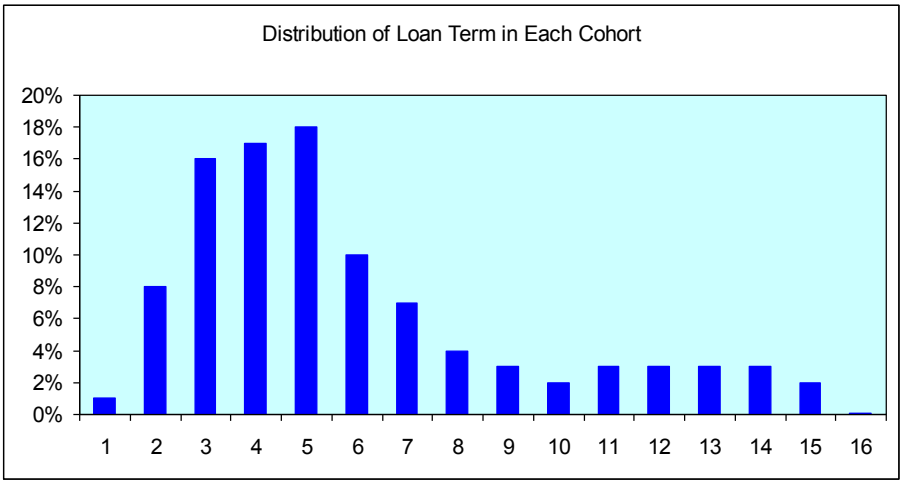
Lifetime cohort analysis shows that the LTVs of loan originated prior to 1991/92 never exceeded 80% LTV and thus posed limited potential for LTV based refinance defaults.

Refinance Default Levels

The incidence of refinance default of both types depends on the origination terms of previous cohorts as well as the number of loans that are coming to term in each period.

DeMontfort University provides some data on the distribution of IPRE loan terms in the industry.

Exhibit 13: Loan Term Distribution



The loan term distribution observed in the 2009 DeMontfort University study indicates that loans have a mean term of 4.7 years and a mode of 5 years, with loans terms varying from 1 to 15 years. The above distribution was applied to all loan cohorts to determine how many loans from each cohort would be seeking refinance in any year. The terminal LTV and ICR of the terminating portion of each cohort was then subjected to a refinance default test where a refinance default is declared if:

LTV at term **>** 85%

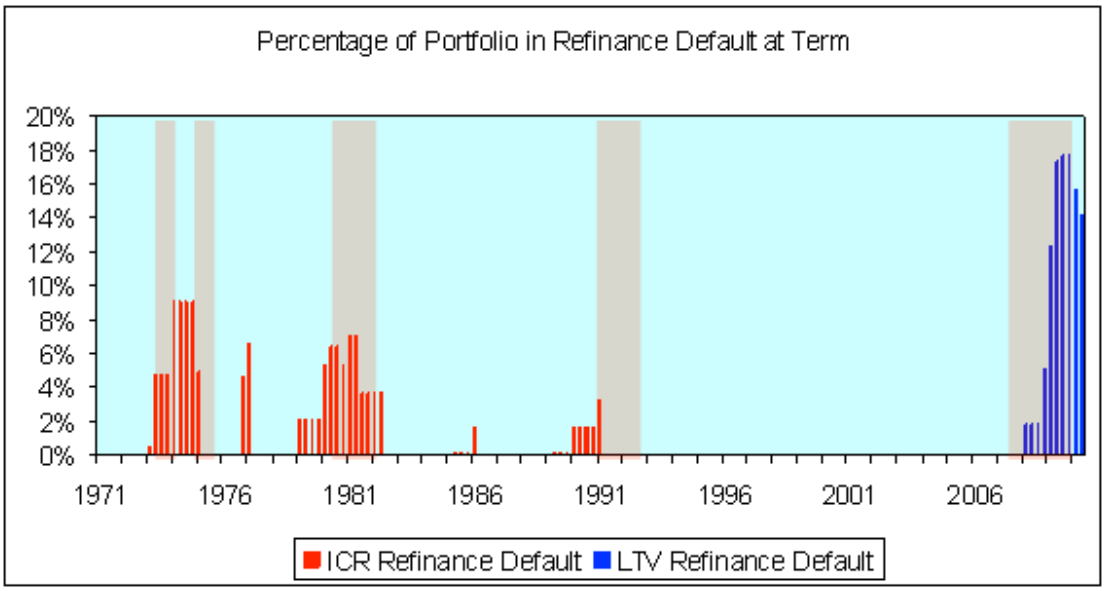
OR

ICR at term **<** 115%

A market level default rate for each year was calculated using the portion of each loan cohort coming to term in the year as a percentage of all remaining loans in the portfolio from all previous cohorts (see Appendix for details).

This refinance default rate is appropriate for fixed or floating rate loans that have been originated at the maximum loan levels within typical banking credit policies. Loans that have been originated at lower levels will exhibit correspondingly lower refinance default rates. The calculated default rates may not be appropriate for loans that have been amortised at significantly higher rates than normal or have been partially refinanced.

Exhibit 14: Combined Estimated Refinance Default Rate



The cohort analysis shows how LTV related refinance defaults have not been a significant feature of most of the past 40 years. Until the persistent lowering of interest rates after 1992, the main cause of refinance risk was interest cover based. Periods of this type of refinance risk were common in the 1970s and 1980s. Once interest rates shifted lower and origination LTVs rose, the cause of refinance defaults changed from ICR breach to LTV breach.

Long periods exist when refinance risk was negligible, followed by bursts of high refinance default. The refinance defaults are somewhat correlated (-34%) with GDP growth but not entirely. In particular, the incidence of refinance defaults were negligible in the 1991/92 recession as falling interest rates quickly relieved pressure on interest cover ratios and the more gentle collateral value falls failed to shift low LTV ratios into the danger region.

Exhibit 15: Refinance default rates by Recession

UK Recessions post 1970	*Average refinance default rate in recession*	*Average default rate in three years following recession*
1974	9.1%	2.9%
1975	0.0%	0.9%
1980-81	5.9%	0.9%
1991-92	0.6%	0.0%
2008-10	12.6%	?

The analysis of refinance default rates in the 2008/10 recession suggests the refinance default rate in the 2008/10 recession is running at about 23 times the level of the 1991/92 recession.

This estimate is likely to understate the difference in one important respect: when ICR breaches are the cause of refinance default, borrowers continue to have equity in the collateral property and are motivated to find other sources of cash to meet interest payments. However, when LTVs exceed 100%, borrowers have little incentive to cooperate with lenders and refinance defaults are more likely to translate into non-performance. The ratio of 23 is therefore likely to underestimate the difference.

Empirical Evidence

DeMontfort University published a single annual survey on default experience, in 2005 from a representative sample containing 17% of the industry. The survey was discontinued owing to lack of interest by the industry. The report concluded that the default rate for the UK IPRE industry was about 0.20% (excluding fraud). No respondent reported any loss.

2005 CRE loss experience	
PD	0.20%
LGD	0.00%

The December 2009 DeMontfort report indicated that:

'There was £18.6bn reported in breach of covenants and £11.8bn in default reported in the first six months of 2009'.

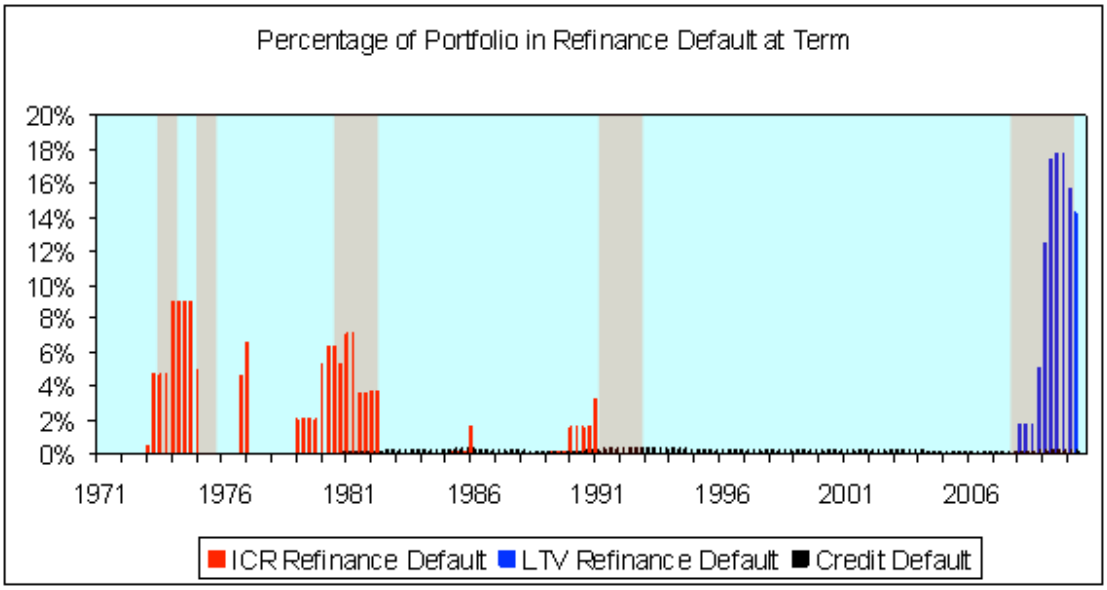
This suggests (out of a book size of £224bn covered by the survey) a refinance default rate in region of 13.5%. These figures must be taken with caution as reporting procedures differ between banks, but the order of magnitude of these volumes is in line with the results from the above analysis.

Reports of CRE loan losses during and after the 1991/92 recession were significant but the authors believe that these refer mostly to development projects and full recourse loans and much less to IPRE loans. Specific data is not publically available.

Conclusions

The differences between the 1991/92 and 2008/10 recessions are particularly significant in terms of their effect on the major component of IPRE lending risk, that is, *refinance (or market) risk*. The level of refinance default rates for typical maximum lending portfolios entering the 2008/10 recession are estimated to be approximately 23 times higher than the refinance default rates in the 1991/92 recession. Conversely, the tenant default rates in the 2008/10 recession appear to be about 38% lower and have risen only half as fast as the equivalent rates in 1991/92. Refinance default levels, are much higher and more volatile than tenant default levels.

Exhibit 16: Refinance and Tenant Default Rates



UK Recessions	*Average refinance default rate in recession*	*Average tenant default rate during recession*	*Average combined default rate*
1991-92	0.55%	0.38%	0.93%
2008-10	12.55%	0.27%	12.82%
Ratio	22.8	0.7	13.7

Lenders should be very cautious in using their 1991/92 default record for calibrating IPRE risk models, especially for refinance risk, without significant adjustments. The

evidence of historic interest rate, collateral value and ERV changes is that refinance defaults do not follow a predictable cyclical pattern, but depend on the 'history' of these market factors and their impact on loan origination for at least a decade before each recession . In the short term, using 1990s default rates to calibrate 2010s risk models may understate the level of risk by more than an order of magnitude.

In the view of the authors, refinance risk or market risk is not suitable for regression models using default histories but should adopt market models that can be calibrated to the historical record of the factors that affect refinance risk such as GDP growth, interest rates, rents and collateral values. The data for these variables are extensive and reliable: refinance risk models can be properly calibrated using the accurate historical data fro these variables back to the 1970s.

Questions

A complete set of data and the cohort model used in the analysis are available from:

Charles Cardozo (07798 643306) charles.cardozo@radleyassociates.com
Julian Goldberg (020 7794 8202) julian.goldberg@radleyassociates.com

Sources

Office of National Statistics, IPD, VAT Office, Companies House.

Appendix: Cohort Model Specification

The main assumption of the cohort analysis is that lenders' policy will be to lend a maximum amount against suitable IPRE collateral subject to a minimum ICR (ICRmin) or maximum LTV (LTVmax), whichever condition is binding. The model assumes a minimum ICR of 125% and a maximum LTV of 80% for an initial setting.

The initial or origination loan amount L(i) for the cohort of loans issued in year x is given as:

(1) $L(i) = \text{Min} [ERV(i) / ((LIBOR(i) + m) . ICRmin) , LTVmax . CV(i)]$

Where ERV(i) is the market prevailing rent in the year of origination (using the IPD all property ERV index), LIBOR(i) is 3 month LIBOR in the year of origination, m is a standard margin over LIBOR (here assumed to be 1%) and CV(i) is the capital value of the collateral property in the year of origination. The capital value CV(i) is calculated as

(2) $CV(i) = ERV(i)/Y(i)$

Where Y(i) is taken from the IPD All Property initial yield series for the origination year.

The origination ICR (ICR(i)) is thus calculated as:

(3) $ICR(i) = ERVi) / (L(i) . (LIBOR(i) + m))$

Once originated, the cohort's refinance ICR changes over time such that:

(4) $ICR(t) = ERV(t) / (L(i). (LIBOR(t) + m))$

Note that the loan is assumed to be non-amortising. The average amortisation rate (DeMontfort University 2009) is about 1.8% and the average depreciation rate of property value (and rents) against the index is about 1.7% so, for most loans, these countervailing factors can be offset and non-amortising loans should reflect a conservative estimate of each loan cohort.

The origination LTV, (LTV(x)) is calculated as follows:

(5) $LTV(i) = L(i)/ CV(i) = L(i).Y(i)/ERV(i)$

Once originated, the cohort's LTVs change over time such that:

(6) $LTV(t)= LTV(i) . (CVI(i)/ CVI(t))$

Where CVI(t) is the IPD all property capital value index at time t.

A refinance default occurs only in a loan's terminal year, (t=T). An ICR based default is given as:

(7) $D_{ICR}(T) = 1$ if $ICT_{(t=T)} < ICR_{DC}$

Where ICR_{DC} is set as the refinance default hurdle, usually set slightly lower than initial policy ICRo and, in this calculation, set at 115%.

Similarly, an LTV based refinance default, in a loan's terminal year T, is

(8) $D_{LTV}(T) = 1$ if $LTV_{(t=T)} > LTV_{DC}$

And refinance default of either type

(9) $D_{REF}(T) = 1$ if $D_{ICR}(T) = 1$ OR $D_{LTV}(T) = 1$

Where LTV_{DC} is set as the refinance default hurdle, usually set slightly higher than the initial policy, LTVo and, in this calculation, set at 85%.

If $\Phi(x,t)$ is the proportion of the loan cohort originated in year x, terminating in year t and $D_{REF}(x,t)$ is the refinance default rate for loans originated in year x in year t, defaults can be given as:

(10) $D(T) = \sum_{(x=1 \text{ to } T)} \Phi(x,T).\ D_{REF}(x,T)$

The default rate for year t, d(t), is arrived at by dividing this quantity by the remaining total cohort

(11) $d(t) = D(t) \,/\, \sum_{(x=1 \text{ to } T)} \sum_{(t=T \text{ to } tmax)} \Phi(x,t)$

A accompanying spreadsheet is available in which users can change assumptions for LTVmin, LTV_{DC}, ICRmin, ICR_{DC} and m.