Equity Capital as a Safety Cushion in the US Banking Sector

Raymond A. K. Cox[1], Randall K. Kimmel[1] & Grace W. Y. Wang[2]

[1] Department of Accounting and Finance, School of Business and Economics, Thompson Rivers University, Kamloops, Canada

[2] Department of Maritime Administration, Texas A&M University, Galveston, USA

Correspondence: Raymond A. K. Cox, School of Business and Economics, 900 McGill Road, Kamloops, British Columbia, V2C 0C8, Canada. Tel: 01-250-852-6387. E-mail: rcox@tru.ca

Abstract

The incidence of US bank failures soared in the financial crisis and economic recession starting in 2008. Financial regulations promulgated by the Federal Reserve and issued through the Basel III Accord raised the minimum equity capital requirements of banks. The intent of the increase in equity capital was to serve as a greater safety cushion to reduce the probability of failure. The purpose of this study is to examine the financial statement variables that distinguish failed (zero equity capital) and nonfailed US banks. The methods employed to investigate our research question are: 1. univariate t-test, and 2. tobit regression analysis with equity capital as the dependent variable. Our results show that the factors explaining equity capital include real estate loans to assets, equity capital to total assets, log of total assets, return on equity, loan loss allowance to total loans, non-performing loans to total assets, total loans to total assets, mortgage-backed securities to total assets, total short-term debt securities to total assets, net gains on sales of loans to total non-interest income, and insured deposits to total deposits. Bank management and financial regulators need to focus on these financial characteristics to ensure adequate equity capital as a safety cushion.

Keywords: problem banks, financial crisis, tobit analysis, equity capital, Basel III

1. Introduction

During the financial crisis and economic recession of 2008 to 2010 financial institution failures soared in the US especially in the banking sector. Investors, analysts and regulators scrutinized bank's financial statements in search of the underlying factors leading to bankruptcy. The financial characteristics examined included the asset mix (lending), earnings profile (interest and fees income, expense composition), liquidity, market risk susceptibility, and the capacity of equity capital to act as a safety cushion absorbing the operating loss shocks.

Governments and financial regulators are compelled to respond to the rise in bank failures and downturn in the economy. Actions taken to combat this financial storm, by the Federal Reserve, included lowering short-term interest rates, increasing loans to banks, expanding the list of collateral eligible to secure loans, and bailing out related financial institutions such as AIG who insured much of the credit default swap market. The federal government responded by reducing corporate income tax rates, adding refunds to individuals, increasing spending and changing legislation to make house foreclosures more difficult resulting in a greater likelihood of refinancing.

Further, financial regulation occurred at the international level, in particular, the Basel III Accord with respect to equity capital on the bank balance sheet. The minimum common equity tier 1 (CET1) to risk-weighted assets (RWA) ratio is 6 percent and 7 percent as of 2015 and 2019 respectively. A supplementary equity capital amount of as much as 2.5 percent can be required during periods of high growth. In conjunction with the international equity capital standards the Federal Reserve mandated a minimum financial leverage ratio (Tier 1 Capital to Total Assets) for US banks of 5 percent for holding companies and 8 percent for systemically important financial institutions (SIFI). In 2016 the eight US SIFIs are Bank of America, Bank of New York Mellon, Citigroup, Goldman Sachs, JP Morgan Chase, Morgan Stanley, State Street and Wells Fargo.

When banks have suffered losses reducing their equity capital to the point of having an inadequate safety cushion their regulator closes them. As outlined by Walter (2004) the closure decision is made by the Office of the Comptroller of the Currency for national-chartered banks, State Government Agencies for state-chartered

banks, and by the Office of Thrift Supervision (dissolved in 2011) for savings associations having a federal government charter. The Federal Deposit Insurance Corporation (FDIC) can decide to close a state-chartered bank without the approval of the State Government Agency. The FDIC typically is appointed the receiver for the closed bank and can choose to conduct a deposit payoff or purchase and assumption.

In this study, first, we investigate the financial statement variables that distinguish failed and nonfailed US banks using a univariate t-test. Second, tobit regression analysis is shown to explain the financial characteristics associated with the amount of equity capital during the financial crisis of 2008 to 2010. Third, some suggestions are made for management on how to operate the bank to augment its equity capital and thereby strengthen its safety cushion to face economic and financial market downturns.

The paper is comprised as follows. Section 2 reviews the literature. Section 3 outlines the data, sample, and hypothesis. Section 4 presents the methodology. Section 5 details and discusses the empirical results. Finally, section 6 concludes the study.

2. Literature Review

Sinkey (1974, 1975) researched problem and non-problem banks finding that the growth in equity capital was not commensurate with the asset growth rate. Hutchison and Cox (2007) demonstrated a positive relation between financial leverage and the return on equity and return on assets. Brunnermeier and Pedersen (2009) as well as Shleifer and Vishny (2010) found that in economic downturns high financial leverage banks must liquidate their loans at a loss reducing their equity capital to the point of bank failure. James (1991) found the losses associated with the sale of closed bank assets to be 40 percent of book value. Acharya et al. (2010) showed that restricted debt capacity, partially caused by low equity capital, further increased the probability of bank failure. Wagner (2007) discovered banks that sell their loans also have a higher risk asset portfolio leading to instability. Moreover, Uzun and Web (2007) presented results that banks who securitize assets are larger and inversely related to the degree of equity capital.

Early warning systems of problem banks have been studied by Gonzalez-Hermosillo (1999), Cihak and Schaeck (2010), and Cole and White (2012), using the CAMELS approach, finding inadequate equity capital was a predictor of failure. CAMELS is the acronym for capital adequacy, asset quality, management quality, earnings, liquidity and sensitivity to the market. Cox and Wang (2014), utilizing discriminant analysis, discovered low equity capital as a factor in US bank failures in the 2008 to 2010 financial crisis. Mare (2015) discovered the contribution of macroeconomic factors to the forecasting of small Italian bank failures, leading to the notion that capital requirements should consider the stage of the business cycle in a countercyclical fashion. Ho et al. (2016) presented evidence that overconfident chief executive officers were more likely to increase the debt ratio prior to a crisis culminating in higher failure rates.

3. Data, Sample, and Hypothesis

Financial statement data for the variables in the models come from the Federal Deposit Insurance Corporation. House price index information (hpindexsa) comes from the Federal Housing Finance Agency and percentage change in personal income (pigrow) comes from the Bureau of Economic Analysis. We access the Bank Data and Statistics under Industry Analysis data assembled by the FDIC from the call reports of US banks for the 2005 to 2010 period. We gather information to calculate 29 independent variables.

The explanatory variables and the predicted relation between them and the dependent variable of bank equity capital is provided in Table 1. We examine five models explaining bank equity capital. The five models delineate different financial characteristic combinations explaining equity capital. The rationale for the different models revolve around the asset mix (loan type), growth of loans and quality of loans.

Book common equity is used as a proxy for market equity. When the common equity of a bank decreases to such an extent that it is negative or zero the bank is closed. There are other banks with very low equity capital that are closed by the respective regulator. In these cases the equity value is worthless. All surviving banks continue to have a positive equity capital balance.

Table 1. Variables and descriptions

Variable	Description	Expected Sign	Rationale
ciloan	commercial and industrial loans to total assets	negative	Like comm_real.
mul_family	multifamily residential real estate loans to real estate loans	positive	People continue to have a need for housing in meltdowns and recession.
sig_family	1–4 family residential loans to real estate loans	positive	Similar to mul_family.
trade_ast	trading account assets to total assets	uncorrelated	Assets owned by customers.
brokdep	brokered deposits to total deposits	negative	This is hot money from brokers raising deposits from high interest certificates of deposit indicative of a high risk bank.
chargeoff	net charge offs to average loans	negative	This is the recognised bad debt experience.
comm_real	commercial real estate loans to real estate loans	negative	These assets are income-producing properties focusing on financing commercial real estate developers. They are sensitive to economic downturns.
cons_devlp	construction and land development loans to real estate loans	negative	These are risky assets sensitive to the business cycle.
foreclosure	real estate acquired of other real estate owned to total assets	negative	This is the process to repossess the security (houses) pledged for loans.
loanast	Total loans to total assets	positive	The higher the level of loans and lease financing receivables to total assets, the safer the bank's portfolio.
loansale	net gains on sales of loans to total non-interest income	negative	Banks that are selling their loans are in need of liquidity which is connected with poor operating performance.
lossallow	loan loss allowance to total loans	negative	Reflects expected bad debt expense.
pastdue	non-performing loans to total assets	negative	Similar to chargeoff
capital	equity capital to total assets	positive	The higher this ratio the greater financial strength and ability to weather the storm in dire times.
cash	cash and due from depository institutions to total assets	positive	If this ratio is too low it implies illiquidity.
debt_sec	total short-term debt securities to total assets	positive	These include government securities owned.
deploan	loans to depository institutions to total assets	positive	These are assets to high-quality institutions.
idloan	loans to individuals to total assets	positive	These loans include credit cards whose risk can be micromanaged with the credit limits and short maturity coupled with high income from interest and fees.
insureddep	Insured deposits to total deposits	positive	The greater the percentage of insured deposits the lower the number of high-value deposits being monitored by their owners leading to lower market discipline.
interbank	interbank deposits to total deposits	positive	Presumably banks monitor the default risk of the banks they deposit in. Thus, a high inter bank is associated with confidence of other banks in the risk of the deposit bank.
loangrowth	growth of total loans and leases	positive	High loan growth rates typically indicate higher credit risk. However, once the economy has entered into a crisis weaker banks susceptible to failure will abandon loan growth.
MBS	mortgage-backed securities to total assets	positive	As stated in the literature, before this crisis MBS were viewed as gilt-edge assets. On the other hand, MBS is of long duration exposing the holder to interest rate risk and heavy losses if rates increase. However, typically in financial crisis regulators combat the calamity by injecting liquidity and decreasing interest rates.
non_income	non-interest income to total income	positive	This variable generates a more stable income stream from sources other than securities and loans.
off-bal	off-balance sheet derivatives to total assets	positive	Normally sophisticated banks engage in derivatives.

realloan	real estate loans to total assets	positive	Prior to the housing asset bubble bursting in the time period of this study loans secured by real estate were considered to be safe, secured by a mortgage on a consumer's primary residence.
roa	return on assets	positive	High roa means high profitability.
sec_asset	securities to total assets	positive	Highly liquid assets
size	log of total assets	positive	In the past most failures were small banks. That and some banks are too big to fail.
tier1	Tier 1 risk-based capital to total risk-weighted assets	positive	Along the same lines as capital.
hpindexsa	Home price index seasonal adjusted		Quarterly All-Transactions Home Price Indexes (Estimated using Sales Prices and Appraisal Data) that estimates the percentage change in home values. Source: the Federal Housing Finance Agency.
pigrow	Growth of personal income		Percent change of the personal income. Source: Bureau of Economic Analysis.

4. Methodology

The first methodology is comparing banks that had a positive amount of capital (common equity>0) to the banks that had zero equity capital. A univariate t-test for mean differences for each of the 29 independent variables listed in Table 1 is conducted.

The second methodology is the use of tobit regression analysis. Tobit regression was created by Tobin (1958). The suitability of tobit rests with the empirics of having a dependent variable with a limiting value typically zero. The limited value is the censored bound versus the upside of having an unlimited value called the uncensored value. In Tobit failed banks that are closed are censored. The efficacy of tobit, as opposed to ordinary least squares (OLS), regression, has been examined by McDonald and Moffitt (1980), Foster and Kalenkoski (2013), and Stewart (2013) among others.

There are five tobit regression equations representing five hypothesized models to explain the financial characteristics of banks with an equity capital amount.

Model 1:

$$Equity = \beta_0 + \beta_1 capital + \beta_2 deploan + \beta_3 idloan + \beta_4 loangrowth + \beta_5 reallaon + \beta_6 roa + \beta_7 size$$

Model 2:

$$Equity = \beta_0 + \beta_1 capital + \beta_2 ciloan + \beta_3 mulfamily + \beta_4 sigfamily + \beta_5 commreal + \beta_6 consdevlp$$
$$+ \beta_7 roa + \beta_8 size$$

Model 3:

$$Equity = \beta_0 + \beta_1 capital + \beta_2 chargeoff + \beta_3 foreclosure + \beta_4 lossallow + \beta_5 pastdue + \beta_6 loangrowth$$
$$+ \beta_7 realloan + \beta_8 roa + \beta_9 size$$

Model 4:

$$Equity = \beta_0 + \beta_1 capital + \beta_2 loanast + \beta_3 loansale + \beta_4 lossallow + \beta_5 pastdue + \beta_6 debtsec$$
$$+ \beta_7 insureddep + \beta_8 MBS + \beta_9 realloan + \beta_{10} roa + \beta_{11} size$$

Model 5:

$$Equity = \beta_0 + \beta_1 capital + \beta_2 loanast + \beta_3 lossallow + \beta_4 pastdue + \beta_5 debtsec + \beta_6 MBS$$
$$+ \beta_7 realloan + \beta_8 roa + \beta_9 size + \beta_{10} hpindexsa + \beta_{11} pigrow$$

The tobit regressions are run with rolling windows, consisting of four combinations of time (the first quarter of 2005, 2006, 2007, and 2008) for each of the four fixed window dependent variable forecasts (2007, 2008, 2009, and 2010).

5. Results

The results for the univariate t-tests are reported in Table 2 for 2007 Quarter 4 and Table 3 for 2008 Quarter 4. Clearly surviving banks have a significantly higher quantity of capital and tier 1 equity than banks that failed. The

highly significant (alpha ≤ 0.01 for each of the 2 years) variables with failed banks having a higher value than surviving banks are realloan, cons_devlp, mul_family, chargeoff, lossallow, pastdue, foreclose, size, brokdep, interbank, and loan_ast. The highly significant variables with a lower value for failed banks versus surviving banks are sig_family, idloan, loangrowth, capital, tier 1, roa, sec_asset, debt_sec, non_income, and cash. This is in line with our a priori expectations with the exception of mul_family, loanast, interbank, realloan and size. Following previous research we believed that high exposure to residential real estate loans, higher percentage of assets in loans, higher percentage of interbank loans, and larger banks in terms of total assets would be associated with higher equity levels and increased odds of survival, but during the crisis which began in 2008 these associations were reversed.

Table 2. Descriptive statistics and univariate t-test for mean differences (2007Q4)

variable	failed banks	Surviving banks	Difference (t-stat)		variable	Failed banks	Surviving banks	Difference (t-stat)	
realloan	64.18	47.38	-16.8		size	12.88	11.91	-0.96	
	(-14.60)	(-19.86)	(-13.35)	***		(-1.61)	(-1.38)	(-7.58)	***
cons_devlp	38.67	15.16	-23.51		roa	-1.84	0.51	2.35	
	(-22.16)	(-15.41)	(-12.45)	***		(-5.39)	(-5.97)	(-5.49)	***
comm_real	28.53	30.58	2.05		sec_asset	12.78	20.07	7.29	
	(-16.47)	(-18.27)	(-1.57)			(-10.52)	(-15.13)	(-8.66)	***
mul_family	4.97	2.82	-2.15		trade_ast	0.09	0.1	0.013	
	(-7.97)	(-5.88)	(-3.42)	***		(-0.39)	(-1.43)	(-0.39)	
sig_family	24.34	40.82	16.48		MBS	5.14	6.32	1.18	
	(-22.94)	(-23.76)	(-9.07)	***		(-6.15)	(-9.27)	(-2.40)	**
Ciloan	8.84	9.35	0.51		off_bal	1.97	3.46	1.49	
	(-7.53)	(-7.65)	(-0.86)			(-7.93)	(-94.47)	(-1.15)	
Idloan	1.64	4.67	3.03		debt_sec	12.2	19.71	7.51	
	(-2.07)	(-6.74)	(-16.96)	***		(-10.36)	(-14.93)	(-9.07)	***
deploan	0.012	0.071	0.06		loansale	1.75	0.16	-1.58	
	(-0.11)	(-1.19)	(-3.54)	***		(-5.11)	(-61.11)	(-1.99)	**
loangrowth	3.75	9.33	5.58		brokdep	16.14	4.06	-12.08	
	(-15.94)	(-165.30)	(-2.49)	**		(-19.86)	(-10.15)	(-7.75)	***
lossallow	1.85	1.29	-0.56		interbank	5.51	1.54	-3.97	
	(-1.33)	(-1.48)	(-5.28)	***		(-13.02)	(-7.74)	(-3.88)	***
chargeoff	0.36	0.11	-0.25		non_income	4.23	10.05	5.82	
	(-0.72)	(-0.40)	(-4.38)	***		(-22.03)	(-17.51)	(-3.35)	***
pastdue	5.72	1.72	-4		cash	2.37	4.65	2.27	
	(-5.57)	(-1.80)	(-9.15)	***		(-2.06)	(-5.55)	(-13.18)	***
foreclose	0.75	0.18	-0.56		loan_ast	76.24	66.2	-10.04	
	(-1.19)	(-0.51)	(-6.04)	***		(-12.37)	(-17.58)	(-10.16)	***
Capital	9.75	12.74	2.99		insureddep	71.91	75.17	3.26	
	(-4.35)	(-9.68)	(-8.35)	***		(-16.19)	(-16.06)	(-2.55)	**
tier1	10.85	22.1	11.25						
	(-4.21)	(-116.18)	(-8.41)	***					

Note. We obtained the results by using the cross-sectional data of 2007Q4. Failure dummy variable defined as banks that failed in 2008-2009. We reported the mean of explanatory variables for surviving and failed banks in the first two columns. The standard deviations are in the parenthesis. We also present the difference in mean and the t-statistic in the third column which tests the mean difference of both sample banks. *, ** and *** significant at the 10%, 5% and 1% level, variables are described in Table 1.

Table 3. Descriptive statistics and univariate t-test for mean differences (2008Q4)

variable	Failed banks	Surviving banks	Difference (t-stat)	variable	Failed banks	Surviving banks	Difference (t-stat)
realloan	63.57	48.45	-15.13	size	12.65	11.98	-0.67 ***
	(-13.78)	(-19.59)	(18.06) ***		(-1.36)	(-1.37)	(-8.30)
cons_devlp	31.95	13.04	-18.91	roa	-7.65	-0.22	7.43 ***
	(-17.82)	(-12.59)	(17.91) ***		(-8.81)	(-5.13)	(-14.31)
comm_real	33.13	31.82	-1.31	sec_asset	10.77	19.8	9.03 ***
	(-16.04)	(-18.47)	(1.36)		(-8.65)	(-15.13)	(-16.89)
mul_family	5.27	3.02	-2.24	trade_ast	0.003	0.08	0.08 ***
	(-7.76)	(-5.89)	(4.87) ***		(-0.02)	(-1.35)	(-5.14)
sig_family	27.04	41.19	14.15	MBS	5.9	7.85	1.95 ***
	(-20.62)	(-23.07)	(-11.42) ***		(-6.65)	(-10.42)	(-4.79)
Ciloan	9.08	9.2	0.13	off_bal	1.06	6.74	5.68
	(-7.42)	(-7.58)	(-0.29)		(-4.36)	(-309.95)	(-1.54)
Idloan	1.66	4.39	2.73	debt_sec	10.6	19.55	8.94
	(-2.22)	(-6.60)	(-18.19) ***		(-8.47)	(-14.96)	(-17.06) ***
deploan	0.03	0.06	0.03	loansale	1.45	0.7	-0.74
	(-0.30)	(-1.30)	(-1.19)		(-14.27)	(-11.59)	(-0.87)
loangrowth	-1.7	3.46	5.16	brokdep	19.19	5.46	-13.73
	(-7.30)	(-20.33)	(-10.61) ***		(-18.59)	(-11.79)	(-12.50) ***
lossallow	2.91	1.4	-1.51	interbank	6.36	1.84	-4.52
	(-2.09)	(-0.86)	(12.32) ***		(-12.96)	(-8.02)	(-5.91) ***
chargeoff	1.15	0.23	-0.92	non_income	-6.98	10.41	17.39
	(-1.32)	(-0.57)	(11.86) ***		(-137.39)	(-20.34)	(-2.16) **
pastdue	9.82	2.37	-7.45	cash	4.81	5.86	1.05
	(-6.40)	(-2.41)	(19.80) ***		(-5.31)	(-7.26)	(-3.27) ***
foreclose	2.03	0.37	-1.66	loan_ast	75.99	66.94	-9.06
	(-2.75)	(-0.76)	(10.27) ***		(-11.07)	(-17.08)	(-13.39) ***
Capital	6.83	11.85	5.02	insureddep	77.3	76.22	-1.08
	(-3.09)	(-7.87)	(-24.92) ***		(-13.86)	(-14.86)	(-1.31)
tier1	8.32	19.62	11.3				
	(-4.08)	(-77.81)	(-12.44) ***				

Note. We obtained the results by using the cross-sectional data of 2008Q4. Failure dummy variable defined as banks that failed in 2009-2010. We reported the mean of explanatory variables for surviving and failed banks in the first two columns. The standard deviations are in the parenthesis. We also present the difference in mean and the t-statistic in the third column which tests the mean difference of both sample banks. *, ** and *** significant at the 10%, 5% and 1% level, variables are described in Table 1.

The results for each of the tobit models 1 through 5, excluding model 4, are in Appendix Tables A1 through A4 respectively. Results for model 4, discussed here, are given in Table 4. Model 4 appears to be the superior model as each and every variable is significant with an alpha level of at least five percent when using data from the first quarter of 2005. The likelihood ratio (LR) chi-square is very high peaking at 1102.55 in 2007 based on 2005 Quarter 1. The probability >Chi-square is significant at greater than 0.0000 across all time periods. The log likelihood is in the range of -129,197 to -132,924 during the entire period. The pseudo R-square is better than the other four models varying from 0.0035 to 0.0041.

Table 4a. Tobit regression results: Model 4 Panel A (zero equity in 2010)

	dependent	2010		2010		2010		2010	
	independent	2005Q1		2006Q1		2007Q1		2008Q1	
1	realloan	-13,666		-16,840		-19,529		-20,412	
		(-10.32)	***	(-10.11)	***	(-10.39)	***	(-9.52)	***
2	capital	12,967		15,654		14,686		11,812	
		(4.09)	***	(4.34)	***	(3.85)	***	(2.75)	***
3	size	437,080		546,857		603,490		659,423	
		(31.23)	***	(30.58)	***	(29.70)	***	(29.69)	***

4	roe	-3,357		-2,624		-3,353		-2,810
		(-2.15)	**	(-1.61)		(-1.74)	*	(-1.84)	*
5	lossallow	-34,024		-26,046		-15,687		-11,419
		(-2.34)	**	(-1.45)		(-0.95)		(-0.63)
6	pastdue	35,303		46,708		40,746		-3,252
		(2.92)	***	(2.95)	***	(2.53)	**	(-0.27)
7	loan_ast	-10,718		-14,200		-11,040		-20,423
		(-4.61)	***	(-4.88)	***	(-3.52)	***	(-5.68)	***
8	MBS	-5,275		-6,259		-8,505		-8,450
		(-2.60)	***	(-2.17)	**	(-2.43)	**	(-2.34)	**
9	debt_sec	-16,182		-20,780		-18,326		-27,909
		(-7.41)	***	(-7.46)	***	(-5.87)	***	(-7.56)	***
10	loansale	-14,150		-8,680		-1,903		772
		(-2.83)	***	(-1.84)	*	(-0.97)		(0.51)
11	insureddep	2,835		6,471		6,410		5,043
		(2.39)	**	(4.40)	***	(3.79)	***	(2.63)	***
12	_cons	-3,658,909		-4,835,800		-5,676,325		-5,329,084
		(-13.89)	***	(-14.62)	***	(-15.50)	***	(-12.68)	***
		Model Statistics						
	observations	8,529		8,358		8,226		8,181
	Censored	136		142		146		151
	Uncensored	8,393		8,216		8,080		8,030
	LR chi2	1,086.4		1,010.3		960.2		999.2
	Prob > chi2	0.0000		0.0000		0.0000		0.0000
	Log likelihood	-131,015		-130,319		-129,164		-129,197
	Pseudo R2	0.0041		0.0039		0.0037		0.0039

Table 4b. Tobit regression results: Model 4 Panel B (zero equity in 2009)

	dependent	2009		2009		2009		2009
	independent	2005Q1		2006Q1		2007Q1		2008Q1
1	realloan	-13,864		-16,960		-19,640		-20,114
		(-10.48)	***	(-10.19)	***	(-10.46)	***	(-9.39)	***
2	capital	13,094		16,034		14,891		12,272
		(4.14)	***	(4.46)	***	(3.90)	***	(2.85)	***
3	size	431,777		538,532		594,031		649,704
		(30.86)	***	(30.13)	***	(29.24)	***	(29.25)	***
4	roe	-3,392		-2,723		-3,319		-2,153
		(-2.18)	**	(-1.67)	*	(-1.73)	*	(-1.40)
5	lossallow	-33,003		-24,550		-14,926		-8,883
		(-2.27)	**	(-1.37)		(-0.91)		(-0.49)
6	pastdue	36,183		47,947		37,698		-16,944
		(3.00)	***	(3.04)	***	(2.34)	**	(-1.36)
7	loan_ast	-10,918		-13,659		-10,642		-19,675
		(-4.70)	***	(-4.71)	***	(-3.40)	***	(-5.47)	***
8	MBS	-4,772		-5,549		-8,005		-8,369
		(-2.35)	**	(-1.92)	*	(-2.29)	**	(-2.32)	**
9	debt_sec	-17,049		-21,086		-18,875		-28,444
		(-7.82)	***	(-7.58)	***	(-6.05)	***	(-7.70)	***
10	loansale	-13,865		-8,602		-2,033		798
		(-2.78)	***	(-1.82)	*	(-1.03)		(0.53)
11	insureddep	2,764		6,145		6,227		4,804
		(2.33)	**	(4.19)	***	(3.68)	***	(2.51)	**
12	_cons	-3,555,618		-4,744,254		-5,559,425		-5,231,439
		(-13.51)	***	(-14.36)	***	(-15.18)	***	(-12.45)	***

Model Statistics				
observations	8,529	8,358	8,226	8,181
Censored	125	127	134	137
Uncensored	8,404	8,231	8,092	8,044
LR chi2	1,070.4	988.3	936.9	977.8
Prob > chi2	0.0000	0.0000	0.0000	0.0000
Log likelihood	-131,180	-130,549	-129,353	-129,415
Pseudo R2	0.0041	0.0038	0.0036	0.0038

Table 4c. Tobit regression results: Model 4 Panel C (zero equity in 2008)

dependent	2008		2008		2008		2008	
independent	2005Q1		2006Q1		2007Q1		2008Q1	
realloan	-13,184		-16,100		-18,405		-18,949	
	(-10.05)	***	(-9.88)	***	(-9.98)	***	(-8.97)	***
capital	13,123		15,751		14,652		11,869	
	(4.18)	***	(4.47)	***	(3.90)	***	(2.80)	***
size	433,451		520,994		579,184		638,148	
	(31.25)	***	(29.76)	***	(28.99)	***	(29.12)	***
roe	-3,333		-2,575		-3,265		-1,741	
	(-2.16)	**	(-1.61)		(-1.73)	*	(-1.12)	
lossallow	-31,699		-22,224		-13,450		-8,616	
	(-2.20)	**	(-1.26)		(-0.83)		(-0.48)	
pastdue	35,765		45,481		41,054		-2,357	
	(2.99)	***	(2.95)	***	(2.60)	***	(-0.19)	
loan_ast	-10,833		-13,230		-10,418		-19,829	
	(-4.70)	***	(-4.65)	***	(-3.38)	***	(-5.59)	***
MBS	-4,741		-5,165		-7,541		-7,536	
	(-2.36)	**	(-1.83)	*	(-2.19)	**	(-2.12)	**
debt_sec	-16,716		-20,510		-18,222		-28,159	
	(-7.72)	***	(-7.53)	***	(-5.94)	***	(-7.73)	***
loansale	-12,413		-7,469		-1,729		803	
	(-2.52)	**	(-1.62)		(-0.89)		(0.54)	
insureddep	2,539		5,247		5,102		3,953	
	(2.16)	**	(3.66)	***	(3.07)	***	(2.09)	**
_cons	-3,590,822		-4,534,848		-5,371,054		-5,089,209	
	(-13.76)	***	(-14.01)	***	(-14.92)	***	(-12.28)	***
Model Statistics								
observations	8,529		8,358		8,226		8,181	
Censored	21		23		25		23	
Uncensored	8,508		8,335		8,201		8,158	
LR chi2	1,092.0		973.3		928.0		971.6	
Prob > chi2	0.0000		0.0000		0.0000		0.0000	
Log likelihood	-132,669		-131,961		-130,889		-131,067	
Pseudo R2	0.0041		0.0037		0.0035		0.0037	

Table 4d. Tobit regression results: Model 4 Panel D (zero equity in 2007)

	dependent	2007		2007		2007	
	independent	2005Q1		2006Q1		2007Q1	
1	realloan	-13,107		-15,840		-18,123	
		(-10.01)	***	(-9.62)	***	(-9.77)	***
2	capital	13,208		16,185		15,043	
		(4.22)	***	(4.55)	***	(3.98)	***
3	size	435,364		542,596		599,707	
		(31.44)	***	(30.68)	***	(29.87)	***

4	roe	-3,424		-2,656		-3,095	
		(-2.22)	**	(-1.64)		(-1.62)	
5	lossallow	-31,743		-23,499		-13,984	
		(-2.20)	**	(-1.32)		(-0.86)	
6	pastdue	35,926		50,372		45,842	
		(3.01)	***	(3.24)	***	(2.89)	***
7	loan_ast	-10,928		-13,989		-11,116	
		(-4.75)	***	(-4.87)	***	(-3.59)	***
8	MBS	-4,755		-5,676		-8,088	
		(-2.37)	**	(-1.99)	**	(-2.34)	**
9	debt_sec	-16,851		-21,008		-18,695	
		(-7.80)	***	(-7.63)	***	(-6.05)	***
10	loansale	-11,599		-7,561		-1,724	
		(-2.36)	**	(-1.62)		(-0.89)	
11	insureddep	2,620		5,451		5,393	
		(2.23)	**	(3.76)	***	(3.23)	***
12	_cons	-3,612,255		-4,756,251		-5,596,531	
		(-13.87)	***	(-14.55)	***	(-15.46)	***
	Model Statistics						
	observations	8,529		8,358		8,226	
	Censored	3		3		2	
	Uncensored	8,526		8,355		8,224	
	LR chi2	1,102.6		1,023.3		974.8	
	Prob > chi2	0.0000		0.0000		0.0000	
	Log likelihood	-132,924		-132,351		-131,287	
	Pseudo R2	0.0041		0.0039		0.0037	

The set of factors in model 4 explaining equity capital includes real estate loans to assets, equity capital to total assets, log of total assets, return on equity, loan loss allowance to total loans, non-performing loans to total assets, total loans to total assets, mortgage-backed securities to total assets, total short-term debt securities to total assets, net gains on sales of loans to total non-interest income, and insured deposits to total deposits. The constant (in all of the models) is negative, very large ($3 million and up), and always significant. It is interesting to note that roe, lossallow, pastdue, and loansale all become less significant after 2005 even as the banks come closer to failure.

Similar to the univariate analysis (Tables 2 and 3), the tobit analysis (Tables A1 through A4 and Table 4) show an unexpected negative effect on equity with increased exposure to multi-family real estate loans, total loans to total assets, and real estate loans to total loans. However, tobit analysis shows a very strong and very large positive association between the size of the bank in terms of total assets and the expected equity value of the bank.

6. Conclusions

This paper studies US banks whose equity capital evaporated resulting in their demise during the financial crisis and economic recession of 2008 to 2010. The univariate t-test method is used to detect mean differences for 29 independent financial variables between censored banks (zero equity capital) and noncensored banks (positive equity capital). The tobit regression analysis indicates that realloan, capital, size, roe, lossallow, pastdue, loan_ast, MBS, debt_sec, loansale, and insureddep are the most significant in determining the amount of equity banks were able to maintain during the crisis. Comparing failed to surviving banks we discover a great disparity in performance. The operations of banks undergoing reductions in equity capital were far different in terms of riskiness of assets, capital structure, liquidity, and profitability. In particular, banks with plummeting equity capital had a loan portfolio tilted towards real estate and construction, higher levels of debt on the balance sheet, lower cash levels, and operating losses.

Managers as well as regulators need to take into consideration the danger that banks can pass into when taking on riskier loans and overexposing their loan portfolio to 1 or 2 industries. The result of such decisions leads to a low quality loan portfolio generating losses that ripple into overall operating losses reducing the amount of the equity capital safety cushion. This situation can lead to bank failure.

References

Acharya, V. V., & Viswanathan, S. (2011). Leverage, moral hazard, and liquidity. *Journal of Finance, 66*, 99-138.

http://dx.doi.org/10.1111/j.1540-6261.2010.01627.x

Brunnermeier, M. K., & Pedersen, L. H. (2009). Market liquidity and funding liquidity. *Review of Financial Studies, 22*, 2201-2238. http://dx.doi.org/10.1093/rfs/hhn098

Cihak, M., & Schaeck, K. (2010). How well do aggregate prudential ratios identify banking system problems? *Journal of Financial Stability, 6*, 130-144. http://dx.doi.org/10.1016/j.jfs.2010.03.001

Cole, R. A., & White, L. J. (2012). Déjà vu all over again: The causes of US commercial bank failures this time around. *Journal of Financial Services Research, 42*, 5-29. http://dx.doi.org/10.1007/s10693-011-0116-9

Cox, R. A. K., & Wang, G. (2014). Predicting the US bank failure: A discriminant analysis. *Economic Analysis and Policy, 44*, 202-211. http://dx.doi.org/10.1016/j.eap.2014.06.002

Foster, G., & Kalenkoski, C. M. (2013). Tobit or OLS? An empirical evaluation under different diary window lengths. *Applied Economics, 45*, 2994-3010. http://dx.doi.org/10.1080/00036846.2012.690852

Gonzalez-Hermosillo, B. (1999). Determinants of ex-ante banking system distress: A macro-micro empirical exploration of some recent episodes. *IMF Working Paper*, 99/33. http://dx.doi.org/10.5089/9781451845167.001

Ho, P. H., Huang, C. W., Lin, C. Y., & Yen, J. F. (2016). CEO overconfidence and financial crisis: Evidence from bank lending and leverage. *Journal of Financial Economics, 120*, 194-209. http://dx.doi.org/10.1016/j.jfineco.2015.04.007

Hutchison, D. E., & Cox, R. A. K. (n. d.). The causal relationship between bank capital and profitability. *Annals of Financial Economics, 20*, 56-62. http://dx.doi.org/10.1142/s2010495207500029

James, C. (1991). The losses realized in bank failures. *Journal of Finance, 45*, 1223-1242. http://dx.doi.org/10.1111/j.1540-6261.1991.tb04616.x

Mare, D. S. (2015). Contribution of macroeconomic factors to the prediction of small bank failures. *Journal of International Financial Markets, Institutions and Money, 39*, 25-39. http://dx.doi.org/10.1016/j.intfin.2015.05.005

McDonald, J. F., & Moffitt, R. A. (1980). The uses of tobit analysis. *Review of Economics and Statistics, 62*, 318-321. http://dx.doi.org/10.2307/1924766

Shleifer, A., & Vishny, R. W. (2010). Unstable Banking. *Journal of Financial Economics, 97*, 306-318. http://dx.doi.org/10.1016/j.jfineco.2009.10.007

Sinkey Jr., J. F. (1974). The way problem banks perform. *The Bankers Magazine, 57*, 40-51.

Sinkey Jr., J. F. (1975). A multivariate statistical analysis of the characteristics of problem banks. *Journal of Finance, 30*, 21-36. http://dx.doi.org/10.1111/j.1540-6261.1975.tb03158.x

Stewart, J. (2013). Tobit or not tobit? *Journal of Economic and Social Measurement, 38*, 263-290. http://dx.doi.org/10.3233/JEM-130376

Tobit, J. (1958). Estimation of relationships for limited dependent variables. *Econometrica, 26*, 24-36. http://dx.doi.org/10.2307/1907382

Uzun, H., & Webb, E. ((2007). Securitization and risk: Empirical evidence on US banks. *Journal of Risk Finance*, *8*, 11-23. http://dx.doi.org/10.1108/15265940710721046

Wagner, W. (2007). The liquidity of bank assets and banking stability. *Journal of Banking and Finance, 31*, 121-139. http://dx.doi.org/10.1016/j.jbankfin.2005.07.019

Walter, J. R. (2004). Closing troubled banks: How the process works. *Federal Reserve Bank of Richmond Economic Quarterly, 90*(1), 51-68. http://dx.doi.org/10.2307/1053138

Appendix A

Table A1. Tobit regression results: Model 1

		Tobit regression results: Model 1 Panel A (zero equity in 2010)							
	dependent	2010		2010		2010		2010	
	independent	2005Q1		2006Q1		2007Q1		2008Q1	
1	realloan	-10,476		-13,737		-15,982		-19,205	
		(-9.98)	***	(-10.31)	***	(-10.52)	***	(-11.31)	***
2	idloan	10,322		10,032		12,702		13,071	
		(3.88)	***	(2.94)	***	(3.22)	***	(2.88)	***
3	deploan	108,801		77,480		73,479		87,849	
		(6.29)	***	(4.63)	***	(3.27)	***	(3.07)	***
4	loangrowth	-136.5868		1.3205		-7.3645		2.2262	
		(-0.38)		(-0.15)		(-0.43)		(0.02)	
5	capital	10,305		14,286		11,629		13,742	
		(2.89)	***	(3.63)	***	(2.93)	***	(3.02)	***
6	size	394,417		479,896		544,773		629,038	
		(28.51)	***	(27.41)	***	(27.20)	***	(28.08)	***
7	roa	-34,724		5,066		-45,220		-47,127	
		(-2.93)	***	(-0.50)		(-2.45)	**	(-2.87)	***
8	constant	-4,227,085		-5,162,766		-5,790,735		-6,689,067	
		(-24.91)	***	(-23.99)	***	(-23.78)	***	(-24.20)	***
		Model Statistics							
	observations	7,719		7,580		7,480		7,434	
	Censored	119		124		130		133	
	Uncensored	7,600		7,456		7,350		7,301	
	LR chi2	886.31		799.46		774.21		826.9	
	Prob > chi2	0.0000		0.0000		0.0000		0.0000	
	Log likelihood	-118,835		-118,416		-117,635		-117,722	
	Pseudo R2	0.0037		0.0034		0.0033		0.0035	
		Tobit regression results: Model 1 Panel B (zero equity in 2009)							
	dependent	2009		2009		2009		2009	
	independent	2005Q1		2006Q1		2007Q1		2008Q1	
1	realloan	-10,370		-13,491		-15,651		-18,537	
		(-9.88)	***	(-10.14)	***	(-10.31)	***	(-10.93)	***
2	idloan	10,540		10,299		13,025		13,298	
		(3.96)	***	(3.02)	***	(3.31)	***	(2.93)	***
3	deploan	108,718		77,619		73,840		89,633	
		(6.29)	***	(0.00)		(3.29)	***	(3.14)	***
4	loangrowth	-166.6617		-1.2300		-7.3554		3.6656	
		(-0.47)		(0.89)		(-0.43)		(0.04)	
5	capital	10,749		14,262		11,659		14,917	
		(3.02)	***	(0.00)		(2.93)	***	(3.28)	***
6	size	391,966		476,757		539,107		622,745	
		(28.34)	***	(0.00)		(26.92)	***	(27.80)	***
7	roa	-35,776		-4,735		-45,001		-38,037	
		(-3.02)	***	(0.64)		(-2.43)	**	(-2.30)	**
8	constant	-4,205,584		-5,135,496		-5,737,946		-6,662,273	
		(-24.80)	***	(0.00)		(-23.56)	***	(-24.11)	***
		Model Statistics							
	observations	7,719		7,580		7,480		7,434	
	Censored	104		110		118		118	
	Uncensored	7,615		7,470		7,362		7,316	
	LR chi2	877.78		790.58		759.17		811.27	
	Prob > chi2	0.0000		0.0000		0.0000		0.0000	
	Log likelihood	-119,055		-118,626		-117,820		-117,953	
	Pseudo R2	0.0037		0.0033		0.0032		0.0034	

		Tobit regression results: Model 1 Panel C (zero equity in 2008)						
	dependent	2008		2008		2008		2008
	independent	2005Q1		2006Q1		2007Q1		2008Q1
1	realloan	-9,807		-12,736		-14,720		-17,569
		(-9.43)	***	(-9.66)	***	(-9.80)	***	(-10.46)	***
2	idloan	9,936		9,534		12,137		12,474
		(3.76)	***	(2.81)	***	(3.10)	***	(2.77)	***
3	deploan	108,536		76,794		72,759		88,744
		(6.32)	***	(4.63)	***	(3.27)	***	(3.13)	***
4	loangrowth	-140.9246		-1.3760		-7.4398		1.4038
		(-0.40)		(-0.16)		(-0.44)		(0.01)
5	capital	10,870		14,976		12,461		14,383
		(3.08)	***	(3.84)	***	(3.17)	***	(3.18)	***
6	size	394,857		480,622		545,664		629,590
		(28.78)	***	(27.69)	***	(27.51)	***	(28.39)	***
7	roa	-35,634		-4,830		-45,461		-44,005
		(-3.03)	***	(-0.48)		(-2.48)	**	(-2.68)	***
8	constant	-4,248,533		-5,200,040		-5,839,780		-6,747,984
		(-25.25)	***	(-24.37)	***	(-24.20)	***	(-24.66)	***
		Model Statistics						
	observations	7,719		7,580		7,480		7,434
	Censored	17		18		20		18
	Uncensored	7,702		7,562		7,460		7,416
	LR chi2	895.08		807.05		781.71		833.48
	Prob > chi2	0.0000		0.0000		0.0000		0.0000
	Log likelihood	-120,304		-119,969		-119,260		119,435
	Pseudo R2	0.0037		0.0034		0.0033		0.0035
		Tobit regression results: Model 1 Panel D (zero equity in 2007)						
	dependent	2007		2007		2007		
	independent	2005Q1		2006Q1		2007Q1		
1	realloan	-9,702		-12,569		-14,482		
		(-9.34)	***	(-9.55)	***	(-9.66)	***	
2	idloan	9,900		9,448		12,007		
		(3.75)	***	(2.79)	***	(3.08)	***	
3	deploan	108,448		76,679		73,053		
		(6.33)	***	(4.63)	***	(3.28)	***	
4	loangrowth	-146.2282		-1.4324		-7.3611		
		(-0.41)		(-0.17)		(-0.43)		
5	capital	11,071		15,252		12,553		
		(3.14)	***	(3.91)	***	(3.20)	***	
6	size	395,415		481,621		546,230		
		(4.82)	***	(27.79)	***	(27.58)	***	
7	roa	-36,646		-4,891		-44,353		
		(-3.12)	***	(-0.48)		(-2.42)	**	
8	constant	-4,258,254		-5,218,745		-5,854,437		
		(-25.34)	***	(-24.50)	***	(-24.31)	***	
		Model Statistics						
	observations	7,719		7,580		7,480		
	Censored	2		2		1		
	Uncensored	7,717		7,578		7,479		
	LR chi2	897.98		810.84		784.51		
	Prob > chi2	0.0000		0.0000		0.0000		
	Log likelihood	-120,519		120,202		-119,540		
	Pseudo R2	0.0037		0.0034		0.0033		

Note. t-statistics are in the parentheses. *, ** and *** indicate statistical significance at 10%, 5%, 1% level, respectively. All variables are described in Table 1.

Table A2. Tobit regression results: Model 2

		2010		2010		2010		2010	
	dependent	2005Q1		2006Q1		2007Q1		2008Q1	
	independent								
1	cons_devlp	-13,159		-16,605		-19,877		-22,165	
		(-8.98)	***	(-9.73)	***	(-10.38)	***	(-10.08)	***
2	comm_real	-10,955		-13,771		-16,648		-18,168	
		(-9.13)	***	(-8.89)	***	(-9.22)	***	(-9.05)	***
3	mul_family	-14,155		-19,361		-9,085		-3,305	
		(-5.04)	***	(-5.17)	***	(-2.09)	**	(-0.72)	
4	sig_family	-4,134.1380		-4,744.0000		-5,125.3680		-6,029.7460	
		(-3.98)	***	(-3.50)	***	(-3.23)	***	(-3.39)	***
5	ciloan	8,037		10,131		13,451		14,358	
		(3.61)	***	(3.59)	***	(4.06)	***	(3.91)	***
6	capital	25,933		29,510		35,245		31,569	
		(8.72)	***	(8.52)	***	(9.48)	***	(7.66)	***
7	size	415,366		507,585		588,116		624,177	
		(30.86)	***	(29.75)	***	(30.05)	***	(29.01)	***
8	roa	-13,322		-4,638		6,691		-30,123	
		(-1.29)		(-0.35)		(0.42)		(-2.06)	**
9	_cons	-4,445,743		-5,435,014		-6,392,030		-6,689,435	
		(-27.59)	***	(-26.43)	***	(-26.94)	***	(-25.24)	***

Tobit regression results: Model 2 Panel A (zero equity in 2010)

Model Statistics

	observations	8,515		8,343		8,217		8,187	
	Censored	136		142		146		150	
	Uncensored	8,379		8,201		8,071		8,037	
	LR chi2	964.5		905		951.58		888.55	
	Prob > chi2	0.0000		0.0000		0.0000		0.0000	
	Log likelihood	-130,779		-129,942		-129,022		-129,292	
	Pseudo R2	0.0037		0.0035		0.0037		0.0034	

Tobit regression results: Model 2 Panel B (zero equity in 2009)

		2009		2009		2009		2009	
	dependent	2005Q1		2006Q1		2007Q1		2008Q1	
	independent								
1	cons_devlp	-13,159		-16,586		-19,680		-21,854	
		(-8.96)	***	(-9.70)	***	(-10.26)	***	(-9.93)	***
2	comm_real	-10,671		-13,322		-16,213		-17,379	
		(-8.90)	***	(-8.60)	***	(-8.98)	***	(-8.66)	***
3	mul_family	-14,745		-19,632		-9,438		-3,487	
		(-5.23)	***	(-5.23)	***	(-2.16)	**	(-0.76)	
4	sig_family	-3,829		-4,339		-4,707		-5,510	
		(0.00)		(-3.20)	***	(-2.96)	***	(-3.10)	***
5	ciloan	8,827		11,100		14,415		15,160	
		(3.98)	***	(3.95)	***	(4.35)	***	(4.14)	***
6	capital	25,765		29,721		35,167		33,072	
		(8.63)	***	(8.61)	***	(9.45)	***	(8.01)	***
7	size	409,605		500,487		579,692		615,826	
		(30.42)	***	(29.33)	***	(29.61)	***	(28.60)	***
8	roa	-13,235		-4,758		6,584		-19,598	
		(-1.28)		(-0.36)		(0.41)		(-1.33)	
9	_cons	-4,402,957		-5,390,737		-6,330,278		-6,668,479	
		(-27.32)	***	(-26.22)	***	(-26.68)	***	(-25.14)	***

Model Statistics

	observations	8,515		8,343		8,217		8,187	
	Censored	127		129		136		138	
	Uncensored	8,388		8,214		8,081		8,049	
	LR chi2	941.41		884.9		927.9		867.7	
	Prob > chi2	0.0000		0.0000		0.0000		0.0000	
	Log likelihood	-130,919		-130,141		-129,180		-129,480	
	Pseudo R2	0.0036		0.0034		0.0036		0.0033	

		Tobit regression results: Model 2 Panel C (zero equity in 2008)							
	dependent	2008		2008		2008		2008	
	independent	2005Q1		2006Q1		2007Q1		2008Q1	
1	cons_devlp	-11,747		-14,120		-17,091		-18,994	
		(-8.12)	***	(-8.48)	***	(-9.10)	***	(-8.78)	***
2	comm_real	-10,686		-12,869		-15,771		-17,201	
		(-8.98)	***	(-8.49)	***	(-8.88)	***	(-8.69)	***
3	mul_family	-12,719		-17,398		-7,734		-1,735	
		(-4.58)	***	(-4.77)	***	(-1.81)	*	(-0.39)	
4	sig_family	-4,041		-4,445		-4,924		-5,697	
		(-3.92)	***	(-3.35)	***	(-3.15)	***	(-3.24)	***
5	ciloan	7,997		10,297		13,115		13,689	
		(3.63)	***	(3.74)	***	(4.03)	***	(3.79)	***
6	capital	25,642		28,553		33,897		30,910	
		(8.70)	***	(8.45)	***	(9.27)	***	(7.58)	***
7	size	410,657		481,809		563,952		602,690	
		(30.76)	***	(28.83)	***	(29.28)	***	(28.38)	***
8	roa	-14,230		-4,593		5,076		-22,072	
		(-1.39)		(-0.35)		(0.32)		(-1.52)	
9	_cons	-4,402,370		-5,181,992		-6,142,342		-6,492,635	
		(-27.54)	***	(-25.72)	***	(-26.30)	***	(-24.81)	***
		Model Statistics							
	observations	8,515		8,343		8,217		8,187	
	Censored	22		23		25		23	
	Uncensored	8,493		8,320		8,192		8,164	
	LR chi2	955.63		848.14		899.37		849.68	
	Prob > chi2	0.0000		0.0000		0.0000		0.0000	
	Log likelihood	-132,425		-131,585		-130,756		-131,151	
	Pseudo R2	0.0036		0.0032		0.0034		0.0032	
		Tobit regression results: Model 2 Panel D (zero equity in 2007)							
	dependent	2007		2007		2007			
	independent	2005Q1		2006Q1		2007Q1			
1	cons_devlp	-11,464		-14,439		-17,251			
		(-7.94)	***	(-8.59)	***	(-9.15)	***		
2	comm_real	-10,791		-13,635		-16,533			
		(-9.09)	***	(-8.90)	***	(-9.26)	***		
3	mul_family	-12,794		-17,692		-7,536			
		(-4.62)	***	(-4.79)	***	(-1.75)	*		
4	sig_family	-4,070		-4,677		-5,094			
		(-3.95)	***	(-3.48)	***	(-3.24)	***		
5	ciloan	7,937		9,972		12,820			
		(3.61)	***	(3.59)	***	(3.92)	***		
6	capital	25,640		29,214		34,315			
		(8.71)	***	(8.55)	***	(9.33)	***		
7	size	412,343		504,488		584,586			
		(30.95)	***	(29.89)	***	(30.21)	***		
8	roa	-14,980		-5,884		4,356			
		(-1.46)		(-0.45)		(0.28)			
9	_cons	-4,416,605		-5,408,261		-6,349,244			
		(-27.68)	***	(-26.57)	***	(27.06)	***		
		Model Statistics							
	observations	8,515		8,343		8217			
	Censored	3		3		2			
	Uncensored	8,512		8,340		8,215			
	LR chi2	966.28		907.83		954.37			
	Prob > chi2	0.0000		0.0000		0.0000			
	Log likelihood	-132,694		-131,976		-131,150			
	Pseudo R2	0.0036		0.0034		0.0036			

Note. t-statistics are in the parentheses. *, ** and *** indicate statistical significance at 10%, 5%, 1% level, respectively. All variables are described in Table 1.

Table A3. Tobit regression results: Model 3

		Tobit regression results: Model 3 Panel A (zero equity in 2010)							
	dependent	2010		2010		2010		2010	
	independent	2005Q1		2006Q1		2007Q1		2008Q1	
1	realloan	-10,645		-13,757		-16,014		-18,192	
		(-11.49)	***	(-11.77)	***	(-12.12)	***	(-12.19)	***
2	loangrowth	-444.632		-5.098		-10.834		-10.191	
		(-1.28)		(-0.70)		(-0.64)		(-0.10)	
3	capital	23,336		26,393		24,571		22,062	
		(7.36)	***	(7.38)	***	(6.65)	***	(5.44)	***
4	size	399,883		496,350		555,312		602,100	
		(31.13)	***	(30.50)	***	(30.15)	***	(29.69)	***
5	roa	-25,860		-4,103		-14,195		-13,310	
		(-2.48)	**	(-0.40)		(-1.31)		(-1.52)	
6	lossallow	-26,713		-23,551		-30,153		-11,322	
		(-1.82)	*	(-1.31)		(-1.69)	*	(-0.62)	
7	pastdue	44,759		56,956		54,587		8,972	
		(3.66)	***	(3.62)	***	(3.38)	***	(0.69)	
8	chargeoff	48,515		-1,079		77,954		45,902	
		(0.43)		(-0.02)		(0.78)		(0.38)	
9	foreclose	20,745		77,865		39,364		9,180	
		(0.39)		(1.05)		(0.57)		(0.18)	
10	_cons	-4,393,884		-5,475,767		-6,063,080		-6,470,373	
		(-27.18)	***	(-26.58)	***	(-26.21)	***	(-25.55)	***
		Model Statistics							
	observations	8,526		8,352		8,233		8,203	
	Censored	136		140		146		151	
	Uncensored	8,390		8,212		8,087		8,052	
	LR chi2	980.04		920.3		897.39		893.26	
	Prob > chi2	0.0000		0.0000		0.0000		0.0000	
	Log likelihood	-131,010		-130,301		-129,305		-129,594	
	Pseudo R2	0.0037		0.0035		0.0035		0.0034	
		Tobit regression results: Model 3 Panel B (zero equity in 2009)							
	dependent	2009		2009		2009		2009	
	independent	2005Q1		2006Q1		2007Q1		2008Q1	
1	realloan	-10,575		-13,531		-15,717		-17,145	
		(-11.42)	***	(-11.58)	***	(-11.90)	***	(-11.50)	***
2	loangrowth	-462.806		-4.992		-10.923		-12.810	
		(-1.33)		(-0.68)		(-0.65)		(-0.13)	
3	capital	23,556		26,309		24,507		22,328	
		(7.43)	***	(7.36)	***	(6.63)	***	(5.51)	***
4	size	395,052		490,002		546,704		593,049	
		(30.73)	***	(30.10)	***	(29.66)	***	(29.22)	***
5	roa	-26,092		-3,374		-14,341		-10,814	
		(-2.51)	**	(-0.33)		(-1.32)		(-1.23)	
6	lossallow	-25,674		-22,348		-30,058		-8,656	
		(-1.75)	*	(-1.24)		(-1.69)	*	(-0.47)	
7	pastdue	46,600		58,985		53,899		-574	
		(3.82)	***	(3.76)	***	(3.34)	***	(-0.04)	
8	chargeoff	49,731		4,381		90,239		35,290	
		(0.44)		(0.06)		(0.90)		(0.29)	
9	foreclose	16,946		78,819		8,485		-37,453	
		(0.32)		(1.07)		(0.12)		(-0.70)	
10	_cons	-4,344,448		-5,413,495		-5,967,113		-6,386,750	
		(-26.87)	***	(-26.28)	***	(-25.78)	***	(-25.19)	***

Model Statistics							
observations	8,526		8,352		8,233		8,203
Censored	125		129		135		138
Uncensored	8,401		8,223		8,098		8,065
LR chi2	957.54		896.6		871.29		869.04
Prob > chi2	0.0000		0.0000		0.0000		0.0000
Log likelihood	-131,179		-130,473		-129,479		-129,799
Pseudo R2	0.0036		0.0034		0.0034		0.0033

Tobit regression results: Model 3 Panel C (zero equity in 2008)

	dependent	2008		2008		2008		2008	
	independent	2005Q1		2006Q1		2007Q1		2008Q1	
1	realloan	-10,015		-12,743		-14,785		-16,640	
		(-10.91)	***	(-11.16)	***	(-11.40)	***	(-11.33)	***
2	loangrowth	-437.464		-5.038		-10.710		-11.139	
		(-1.27)		(-0.70)		(-0.64)		(-0.11)	
3	capital	23,436		26,171		24,541		22,185	
		(7.45)	***	(7.48)	***	(6.76)	***	(5.55)	***
4	size	398,367		477,448		537,800		588,859	
		(31.27)	***	(29.96)	***	(29.69)	***	(29.44)	***
5	roa	-26,710		-3,399		-14,720		-11,028	
		(-2.59)	***	(-0.34)		(-1.38)		(-1.27)	
6	lossallow	-24,428		-19,891		-27,409		-8,507	
		(-1.68)	*	(-1.13)		(-1.56)		(-0.47)	
7	pastdue	44,603		54,979		54,896		8,974	
		(3.68)	***	(3.58)	***	(3.47)	***	(0.70)	
8	chargeoff	56,559		4,681		79,907		-1,937	
		(0.50)		(0.07)		(0.81)		(-0.02)	
9	foreclose	29,576		77,002		14,289		15,736	
		(0.57)		(1.07)		(0.21)		(0.31)	
10	_cons	-4,393,449		-5,282,251		-5,891,243		-6,364,687	
		(-27.41)	***	(-26.19)	***	(-25.89)	***	(-25.47)	***

Model Statistics							
observations	8,526		8,352		8,233		8,203
Censored	21		23		25		23
Uncensored	8,505		8,329		8,208		8,180
LR chi2	983.52		887.65		868.69		868.08
Prob > chi2	0.0000		0.0000		0.0000		0.0000
Log likelihood	-132,666		-131,912		-131,027		-131,463
Pseudo R2	0.0037		0.0034		0.0033		0.0033

Tobit regression results: Model 3 Panel D (zero equity in 2007)

	dependent	2007		2007		2007	
	independent	2005Q1		2006Q1		2007Q1	
1	realloan	-9,893		-12,620		-14,639	
		(-10.80)	***	(-10.93)	***	(-11.22)	***
2	loangrowth	-432.270		-5.052		-10.695	
		(-1.26)		(-0.70)		(-0.64)	
3	capital	23,582		26,927		25,175	
		(7.51)	***	(7.62)	***	(6.90)	***
4	size	400,033		497,276		556,416	
		(31.45)	***	(30.88)	***	(30.55)	***
5	roa	-27,361		-4,132		-14,621	
		(-2.65)	***	(-0.41)		(-1.36)	
6	lossallow	-24,364		-20,748		-28,373	
		(-1.67)	*	(-1.16)		(-1.61)	
7	pastdue	45,030		59,476		58,675	
		(3.73)	***	(3.84)	***	(3.68)	***
8	chargeoff	56,384		2,255		81,687	
		(0.50)		(0.03)		(0.82)	
9	foreclose	28,279		82,682		30,822	
		(0.54)		(1.14)		(0.45)	
10	_cons	-4,417,416		-5,528,607		-6,125,452	
		(-27.61)	***	(-27.13)	***	(-26.78)	***

Model Statistics			
observations	8,526	8,352	8,233
Censored	3	3	2
Uncensored	8,523	8,349	8,231
LR chi2	993.01	934.68	912.92
Prob > chi2	0.0000	0.0000	0.0000
Log likelihood	-132,921	-132,303	-131,426
Pseudo R2	0.0037	0.0035	0.0035

Note. t-statistics are in the parentheses. *, ** and *** indicate statistical significance at 10%, 5%, 1% level, respectively. All variables are described in Table 1.

Table A4. Tobit regression results: Model 5

	Tobit regression results: Model 5 Panel A (zero equity in 2010)							
	dependent	2010		2010		2010		2010
	independent	2005Q1		2006Q1		2007Q1		2008Q1
1	realloan	-12858.08		-15097.09		-17703.75		-18777.59
		(-9.88)	***	(-9.07)	***	(-9.56)	***	(-8.40)	***
2	capital	10,255		13,289		12,482		8,840
		(3.54)	***	(4.02)	***	(3.51)	***	(2.23)	**
3	size	418,226		512,689		572,429		631,747
		(32.04)	***	(30.69)	***	(30.18)	***	(30.46)	***
4	roa	-11,192		6,722		-4,078		-8,813
		(-1.16)		(0.75)		(-0.43)		(-1.05)
5	loan_ast	-9,980		-12,780		-9,993		-19,538
		(-4.35)	***	(-4.48)	***	(-3.27)	***	(-5.55)	***
6	lossallow	-17,836		-26,159		-14,076		-7,054
		(-1.72)	*	(-1.46)		(-0.86)		(-0.39)
7	pastdue	38,239		51,005		48,948		4,107
		(3.22)	***	(3.24)	***	(3.09)	***	(0.35)
8	MBS	-4,869		-5,424		-7,340		-7,923
		(-2.40)	**	(-1.88)	*	(-2.12)	**	(-2.21)	**
9	debt_sec	-14,700		-17,848		-16,298		-26,247
		(-6.82)	***	(-6.62)	***	(-5.44)	***	(-7.35)	***
10	pi_grow	-572,115		-3,072,812		491,848		606,637
		(-0.48)		(-1.50)		(0.15)		(0.27)
11	hpindex_sa	-1,145		-1,392		-2,190		-2,164
		(-2.08)	**	(-2.32)	**	(-3.29)	***	(-2.50)	**
12	_cons	-3,145,858		-3,832,873		-4,566,586		-4,334,350
		(-12.43)	***	(-12.25)	***	(-13.22)	***	(-10.73)	***
	Model Statistics							
	observations	8,563		8,400		8,274		8,238
	Censored	137		144		147		151
	Uncensored	8,426		8,256		8,127		8,087
	LR chi2	1,061		983		947		988
	Prob > chi2	0.0000		0.0000		0.0000		0.0000
	Log likelihood	-131,529		-130,951		-129,902		-130,094
	Pseudo R2	0.0040		0.0037		0.0036		0.0038
	Tobit regression results: Model 5 Panel B (zero equity in 2009)							
	dependent	2009		2009		2009		2009
	independent	2005Q1		2006Q1		2007Q1		2008Q1
1	realloan	-13295.26		-15355.35		-17873.44		-18785.66
		(-10.18)	***	(-9.23)	***	(-9.66)	***	(-8.41)	***
2	capital	9,950		13,590		12,377		9,089
		(3.43)	***	(4.12)	***	(3.48)	***	(2.29)	**
3	size	413,480		505,488		563,298		622,031
		(31.67)	***	(30.26)	***	(29.69)	***	(29.97)	***
4	roa	-9,740		5,409		-3,962		-6,000
		(-1.01)		(0.61)		(-0.41)		(-0.71)

5	loan_ast	-10,381		-12,343		-9,550		-18,604
		(-4.53)	***	(-4.33)	***	(-3.13)	***	(-5.29)	***
6	lossallow	-30,726		-24,803		-13,192		-5,013
		(-2.28)	**	(-1.39)		(-0.81)		(-0.28)
7	pastdue	41,780		52,790		46,067		-10,661
		(3.51)	***	(3.37)	***	(2.91)	***	(-0.88)
8	MBS	-4,497		-4,828		-6,952		-7,928
		(-2.22)	**	(-1.67)	*	(-2.00)	**	(-2.21)	**
9	debt_sec	-15,677		-18,246		-16,708		-26,717
		(-7.28)	***	(-6.77)	***	(-5.57)	***	(-7.48)	***
10	pi_grow	-1,005,064		-2,908,988		619,662		47,046
		(-0.85)		(-1.42)		(0.19)		(0.02)
11	hpindex_sa	-972		-1,175		-1,969		-1,920
		(-1.77)	*	(-1.96)	*	(-2.96)	***	(-2.22)	**
12	_cons	-3,042,628		-3,813,214		-4,517,075		-4,286,908
		(-12.00)	***	(-12.21)	***	(-13.08)	***	(-10.61)	***

Model Statistics				
observations	8,563	8,400	8,274	8,238
Censored	128	129	136	138
Uncensored	8,435	8,271	8,138	8,100
LR chi2	1,045	961	921	966
Prob > chi2	0.0000	0.0000	0.0000	0.0000
Log likelihood	-131,666	-131,180	-130,077	-130,298
Pseudo R2	0.0040	0.0037	0.0035	0.0037

Tobit regression results: Model 5 Panel C (zero equity in 2008)

	dependent	2008		2008		2008		2008
	independent	2005Q1		2006Q1		2007Q1		2008Q1
1	realloan	-12502.36		-14606.65		-16829.17		-17765.54
		(-9.70)	***	(-8.97)	***	(-9.25)	***	(-8.06)	***
2	capital	10,196		13,502		12,433		8,850
		(3.55)	***	(4.18)	***	(3.56)	***	(2.26)	**
3	size	416,088		491,972		552,533		614,897
		(32.16)	***	(30.08)	***	(29.63)	***	(30.06)	***
4	roa	-11,648		5,424		-4,303		-6,429
		(-1.22)		(0.62)		(-0.46)		(-0.77)
5	loan_ast	-10,167		-12,012		-9,546		-18,769
		(-4.48)	***	(-4.31)	***	(-3.18)	***	(-5.41)	***
6	lossallow	-16,672		-22,111		-11,788		-5,195
		(-1.62)		(-1.26)		(-0.73)		(-0.29)
7	pastdue	39,305		49,016		48,060		2,944
		(3.35)	***	(3.20)	***	(3.09)	***	(0.25)
8	MBS	-4,383		-4,468		-6,563		-7,151
		(-2.18)	**	(-1.58)		(-1.92)	*	(-2.02)	**
9	debt_sec	-15,330		-17,942		-16,416		-26,483
		(-7.17)	***	(-6.80)	***	(-5.57)	***	(-7.51)	***
10	pi_grow	-713,794		-2,802,326		1,218,965		255,486
		(-0.61)		(-1.40)		(0.37)		(0.12)
11	hpindex_sa	-834		-1,067		-1,672		-1,655
		(-1.53)		(-1.82)	*	(-2.57)	**	(-1.94)	*
12	_cons	-3,161,363		-3,726,046		-4,507,159		-4,309,906
		(-12.60)	***	(-12.18)	***	(-13.28)	***	(-10.83)	***

Model Statistics				
observations	8,563	8,400	8,274	8,238
Censored	22	23	25	23
Uncensored	8,541	8,377	8,249	8,215
LR chi2	1,068	951	916	962
Prob > chi2	0.0000	0.0000	0.0000	0.0000
Log likelihood	-133,182	-132,619	-131,640	-131,963
Pseudo R2	0.0040	0.0036	0.0035	0.0036

	Tobit regression results: Model 5 Panel D (zero equity in 2007)					
	dependent	2007		2007		2007
	independent	2005Q1		2006Q1		2007Q1
1	realloan	-12380.29		-14353.91		-16572.16
		(-9.62)	***	(-8.72)	***	(-9.06)	***
2	capital	10,276		13,821		12,689
		(3.59)	***	(4.23)	***	(3.61)	***
3	size	417,588		512,197		571,823
		(32.33)	***	(31.00)	***	(30.50)	***
4	roa	-12,273		4,997		-4,351
		(-1.29)		(0.57)		(-0.46)
5	loan_ast	-10,187		-12,703		-10,117
		(-4.49)	***	(-4.50)	***	(-3.35)	***
6	lossallow	-16,715		-23,609		-12,486
		(-1.63)		(-1.33)		(-0.77)
7	pastdue	39,552		54,426		53,089
		(3.38)	***	(3.52)	***	(3.39)	***
8	MBS	-4,413		-4,999		-7,131
		(-2.20)	**	(-1.75)	*	(-2.08)	**
9	debt_sec	-15,384		-18,283		-16,714
		(-7.21)	***	(-6.85)	***	(-5.64)	***
10	pi_grow	-598,309		-2,992,164		916,973
		(-0.51)		(-1.48)		(0.28)
11	hpindex_sa	-794		-902		-1,584
		(-1.46)		(-1.52)		(-2.42)	**
12	_cons	-3,187,616		-3,953,276		-4,717,640
		(-12.73)	***	(-12.79)	***	(-13.83)	***
	Model Statistics					
	observations	8,563		8,400		8,274
	Censored	3		3		2
	Uncensored	8,560		8,397		8,272
	LR chi2	1,078		999		961
	Prob > chi2	0.0000		0.0000		0.0000
	Log likelihood	-133,452		-133,010		-132,039
	Pseudo R2	0.0040		0.0037		0.0036

Note. t-statistics are in the parentheses. *, ** and *** indicate statistical significance at 10%, 5%, 1% level, respectively. All variables are described in Table 1.

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