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Are Incurred Loss Standards Countercyclical? A Case Study Using U.S. Bank Holding Company Data

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Abstract: After the 2008 global financial crisis, U.S. bank holding companies needing to cover larger-than-expected loan losses raised concerns that existing provision accounting may be procyclical. Most related studies have found evidence of procyclicality using either aggregate time-series data or "as-reported" panel data. We test the null hypothesis that provisions were a constant fraction of nonperforming loans across the economic cycle. We create a "forced" panel, which incorporates the entities acquired by each holding company in the quarters prior to their mergers. As in the related literature, we fail to reject the null hypothesis with "as-reported" data; however, we reject the null hypothesis with the "forced" panel. This finding suggests that holding companies built up provisions to some degree during the pre-crisis period to cover larger future losses. These actions reduced capital and likely depressed lending in the pre-crisis period; such countercyclical impacts are consistent with post-crisis macroprudential policies.

Keywords: banks; accounting; provisions; loan losses; procyclical

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1. Introduction

After the 2008 global financial crisis, U.S. bank holding companies needing to cover larger than expected loan losses raised concerns that existing provision accounting may be procyclical—i.e., banks under provision for loan losses in economic expansions allow for higher dividend payouts and more aggressive lending, so they need to dramatically increase provisions in a downturn, resulting in reduced earnings, capital, and lending. Financial institutions expressed frustration because they argued they could not record losses they expected, since the probable threshold for the incurred loss (IL) standard had not been met. Investors made estimates of expected credit losses using forward-looking information and devalued financial institution liabilities before accounting losses were recognized (see Financial Accounting Standards Board 2016). Moreover, bank regulators voiced concern that the IL standard contributed to procyclicality of bank lending because bank's loan loss reserves were insufficient to cover credit losses during the economic downturn (Basel Committee on Banking Supervision 2017). By delaying the recognition of expected losses under the IL standard, greater provisions were required during the downturn, and therefore, capital requirements were more likely to be binding than otherwise (see, for example, Bernanke 2009 and Van den Heuvel 2009). Together, these assertions suggest that provisioning was viewed as "too procyclical" under the IL standard, and this procyclicality contributed to the observed severe economic downturn during the financial crisis.

The empirical literature on bank provisioning under the IL standard cast doubts on bankers' assertion that they assumed that all loans would be repaid until evidence to the contrary (i.e., a "probable" loss or trigger event) was identified. In Section 2, we survey the bank provisioning literature and demonstrate that researchers found evidence that some banks had smaller delays in loss recognition than others, some bankers provisioned more when their earnings were higher, and some bankers provisioned more when their capital ratios were above required minimums. This documented heterogeneity in loss provisioning practices suggests that discretion has played a significant role in the way that banks measured and recognized credit losses under the IL standard. As a matter of fact, some researchers have found support for hypotheses consistent with bank provisioning being countercyclical (i.e., provisions being built up during credit or economic expansions, and being drawn down during credit busts or economic downturns) under the IL standard, while others have found support for hypotheses consistent with bank provisioning being procyclical. These hypotheses, which are discussed in Section 2, underscore the need to determine empirically whether the IL standard was predominantly procyclical.

Since bankers' use of discretion has been documented, it is essential to understand the drivers of the cyclicality of bank provisioning to anticipate the potential effects of making changes to accounting and regulatory standards. For example, if bank provisioning before the financial crisis reflected bankers' best assessment of expected losses, then using an expected loss standard could have only modest impacts on the need to provision during a future crisis and on the resulting curtailment of lending due to capital constraints. Furthermore, if bankers allocate part of their capital above regulatory requirements to pre-fund future credit losses through provisions, then boosting such requirements during credit booms, say by imposing countercyclical capital buffers, may affect the cyclicality of provisioning ex post.

This paper considers the drivers of the cyclicality of bank provisions (i.e., the expense account on a bank's income statement that is frequently updated with estimates and calculations based on a bank's loan portfolio performance and customer default experience) and loan loss allowances (i.e., the "contra-asset" account on a bank's balance sheet that reflects bank management's expectation for uncollected interest, or principle, or both, in its lending business). These drivers are considered over an eighteen-year period, 2002: Q1–2019: Q4, using a specification similar to one used by Cummings and Durrani (2016). This sample period runs from the quarter after the end of the recession following the dotcom bubble to the quarter before the scheduled implementation of a new accounting standard, the current expected credit loss standard. The specification tests the extent to which regulatory provisions and the associated loan loss allowances are influenced by credit risk, asset quality, the current state of the business cycle, and forward-looking indicators of economic activity. We posit that the sensitivity of provisions (loan loss allowances) to these factors may vary across boom, and bust, periods. For this reason, we stratify our sample into three periods using National Bureau of Economic Research dates for business cycle expansions and contractions—pre-crisis (2002: Q1–2007: Q3; credit boom), crisis (2007: Q4–2009: Q2; credit bust), and post-crisis (2009: Q3–2019: Q4; credit boom)—and test for statistical differences in coefficients across these periods using identical specifications.

Importantly, most of the previous studies finding evidence of provisioning procyclicality used either aggregate time-series data or "as reported" panel data. In this study, we are the first to consider whether the perceptions that provisions were procyclical during the 2008 global financial crisis may have resulted from observers considering the provisioning behavior of surviving U.S. holding companies without taking into consideration the provisions that had been accumulated by the acquired bank holding companies and thrifts that were near failure. During the crisis, for example, JP Morgan Chase acquired Bears Sterns and Washington Mutual, Bank of America acquired Merrill Lynch, and Wells Fargo acquired Wachovia. If one ignores the provisions made and loan loss allowances that were built up by the acquired holding companies in the pre-crisis period, it could potentially understate the extent of preparedness for the losses that were booked in the

crisis by the acquirers, particularly if the acquired firms were riskier during the pre-crisis boom period than the holding companies that eventually became their acquirers. None of the previous studies that considered the effects of mergers dealt with this potential "survivor bias" problem (see Section 2).

For our analysis, we create a forced merged bank holding company panel (i.e., "forced panel"), which incorporates the balance sheet and income statement information of all entities acquired by each holding company that have been combined either through merger or acquisition in prior quarters. Our methodology for creating this forced panel is described in Section 3.

We tested the null hypothesis that provisions were a constant fraction of nonperforming loans across the economic cycle. As in the previous literature, we failed to reject the null hypothesis with "as reported" data; however, we can reject the null hypothesis with the "forced panel" data. In this manner, we document that U.S. bankers, even the unsuccessful ones, appear to have used their considerable discretion to build allowances during the pre-crisis period to account for expected losses during a normal business cycle downturn. These actions reduced capital and likely depressed lending in the pre-crisis boom period; such actions with *countercyclical* impacts appear to be consistent with the envisioned macroprudential policies of regulators that were developed in the aftermath of the crisis.

During the 2008 financial crisis, loan losses and nonperforming loans were likely higher than bankers' expectations that were based on recent historical experience. Indeed, the Great Recession that followed the 2008 financial crisis was severe with real GDP declining by 5.1 percent compared to an average of 2 percent over the ten prior recessions in the postwar period (range of 0.3 and 3.7 percent). Unemployment during the Great Recession peaked at 10 percent compared to an average of 7.6 percent (range of 6.1 and 10.8 percent) during the postwar period. Since the Great Recession was not comparable to a normal business downturn, loan loss allowances built up prior to 2008 under the IL standard were insufficient. As loan quality deteriorated, the rate of provisioning used by banks is estimated to be a *constant* fraction of their nonperforming loans after controlling for the effects of credit risk, capital adequacy, bank earnings, and the economic cycle. These actions, however, appeared to have had *procyclical* impacts as greater provisions (concomitant with higher nonperforming loans) increased loan loss allowances, reduced capital, and depressed lending. It is essential to recognize that this procyclicality in provisioning resulted from a lack of perfect foresight, rather than from the inability of bankers to provision in line with their expected loan losses.

For allowances, we found a greater sensitivity to nonperforming loans in the pre-crisis period compared to the crisis period that is significant at the one percent level of confidence when the forced merged holding companies were considered, but this greater sensitivity was only significant at the 10 percent level of confidence when mergers were not considered. The greater impact of nonperforming loans on allowances in the pre-crisis period is consistent with the building up of loan loss allowances for future expected losses that were embedded in the loan portfolios of U.S. bank holding companies during this period, a result that would be ignored by researchers using reported data, which are not forced merged, and the standard five percent confidence level threshold.

With regard to macroeconomic conditions, the expected negative relationship between provisioning and lagged economic growth—consistent with credit losses being lower in an improving macroeconomic environment—is validated for the pre-crisis period (consistent with Bikker and Metzemakers 2005). While this relationship also holds during the crisis period if one does not take into consideration the mergers that occurred in prior quarters, it vanishes if one utilizes the forced merged bank holding company data. Correspondingly, allowances are built up in credit booms and drawn down in credit busts, a finding that is not surprising; but this sensitivity to the credit cycle is more significant when holding company data are forced merged.

As noted earlier, the next section discusses various hypotheses for the cyclicality of bank provisioning and provides a brief literature review. Section 3 describes the data, our forced panel methodology, and empirical specifications used to consider the cyclical behavior of U.S. bank provisions and loan loss allowances. Section 4 provides our findings; and Section 5 concludes with a discussion of their practical implications for accounting standards, bank lending procyclicality, and financial stability.

2. Literature Review

Researchers have considered various hypotheses for why provisions are procyclical or countercyclical over the credit cycle or business cycle. One procyclical hypothesis is that bankers respond to lower incurred loan losses and/or the identification of fewer problem loans, in an economic expansion, by reducing loan loss provisions, which allows for higher dividend payouts and/or more aggressive lending; in a downturn, there are higher incurred losses and/or more identified problem loans, so bankers increase provisions, resulting in reduced earnings, capital pressures, and reductions in lending (e.g., Laeven and Majnoni 2003).

Another procyclical provisioning hypothesis, known as the institutional memory hypothesis, focuses on the evolution of loan officers' abilities to generate and manage the soundness of loans over the credit or business cycle (see Berger and Udell 2004). As an expansion evolves, loan officers may be less able to assess loan quality. Higher loan risks are revealed later near the end of the expansion because it takes time for loan performance problems to emerge. As a result, provisions are generally low during most of the expansion, then rise dramatically during the downturn.

In contrast, a countercyclical provisioning hypothesis argues that banks should recognize underlying risk and build up loss reserves in good times that would be drawn down in bad times (e.g., Borio et al. 2001; Bikker and Metzemakers 2005; Bouvatier and Lepetit 2012). Consistently with this view, provisioning decisions would be based on the entire future profile of expected losses, which could also incorporate the build-up of financial imbalances that increase the likelihood of an economic downturn. Such expected losses could depend on forward-looking measures of credit market conditions (e.g., Cummings and Durrani 2016).

Other researchers have focused on the discretionary use of provisioning. Under the income smoothing hypothesis, banks may utilize provisioning to manage earnings to reduce earnings variability, to signal lower risk, and/or to reduce funding costs. According to the capital management hypothesis, bankers may utilize provisions to reduce the cost of raising capital, take advantage of implicit or explicit guarantees that make debt funding cheaper, and/or shareholder preferences for dividend payments. These hypotheses are also consistent with countercyclical provisioning by banks.

Since there are hypotheses that argue for bank provisioning to be procyclical and hypotheses that argue for bank provisioning to be countercyclical with respect to the credit or business cycle, it is an empirical question whether such provisioning is on-balance one or the other, and another is whether the stage of the business or credit cycle matters. Table 1 considers key papers in the provisioning literature that have considered procyclicality from two angles: (1) Could procyclicality vary over the business cycle? (2) How did the authors treat mergers, if applicable?

Table 1. Literature Summary.

Author(s)	Title	Accounting Standards/LLP Regimes Covered	Time Periods, Countries Covered	Consideration of Mergers?	Could Procyclicality Vary Over Business Cycle?
Abad and Suarez (2018)	Assessing the procyclicality of expected credit loss provisions	IL, EL (CECL, IFRS 9)	1981–2015, EU countries	None	Considered probability that a bank needs to recapitalize to finance LLP. Demonstrated that there are more loan losses, or more sudden falls in regulatory capital, right at the beginning of contractionary phases of the business or credit cycle.
Balasubramanyan et al. (2017)	Evidence of forward-looking loan loss provisioning with credit market information	IL	Q1 1997–Q3 2011, US	Kept observations with mergers that used pooling of interest accounting. Dropped observations corresponding to the quarter in which the merger took place and the accounting method used was purchase accounting.	Studied loan loss provisioning over the credit cycle using three distinct phases: pre-crisis, crisis, and post-crisis to control for structural breaks. Argued that the value of an additional dollar of equity is higher during an economic downturn than in an expansion. Distinguished between credit cycle and business cycle using Senior Loan Officer Opinion Survey information.
Beatty and Liao (2011)	Do delays in expected loss recognition affect banks' willingness to lend?	IL	Q3 1993–Q2 2009, US	To address concerns that their analysis might be affected by mergers and acquisitions, excluded all observations with non-loan asset growth exceeding 10% in any quarter.	Exploited variation in the delay in expected loss recognition in IL regime to consider reductions in lending during recessionary periods relative to expansionary periods. These reductions are lower for banks that delay less.
Berger and Udell (2004)	The institutional memory hypothesis and the procyclicality of bank lending behavior	IL	1980–2000, US	To ensure that their results were not due to mergers, the authors ran their regressions with only non-merging banks (i.e., deleting observations on banks engaged in mergers over the $[t - 10, t]$ interval.	Stylized fact: Past due, nonaccrual, provisions, and charge-offs are generally low during most of the expansion, start to appear at the end of the expansion, then rise dramatically during the downturn. Authors find support for the "institutional memory hypothesis" that is driven by the deterioration in the ability of loan officers over the bank's lending cycle that results in an easing of credit standards. This deterioration is partly due to a proportional increase in officers that have never experienced a loan bust, and partly due to the atrophying skills of experienced officers as time passes since their last problem-loans experience.

Table 1. *Cont.*

Author(s)	Title	Accounting Standards/LLP Regimes Covered	Time Periods, Countries Covered	Consideration of Mergers?	Could Procyclicality Vary Over Business Cycle?
Bikker and Metzemakers (2005)	Bank provisioning behaviour and procyclicality	IL	1991–2001, 45 OECD countries	None	Provisioning depends significantly on the business cycle as evidenced by the negative relation between GDP growth and provisioning. The procyclical effect—buffers need to grow during downturns—is mitigated by the impact of the banks' earnings on provisions and by the positive effect of loan growth on provisioning. The data also support the capital management hypothesis: banks provision more when their capital ratio is low.
Bouvatier and Lepetit (2012)	Provisioning rules and bank lending: a theoretical model	NA	NA	None	Developed a partial equilibrium model of the banking firm to show that a backward-looking provisioning system amplifies the procyclicality of loan market fluctuations.
Covas and Nelson (2018)	Current expected credit loss: lessons from 2007–2009	IL, CECL (US GAAP)	1977–2017, US	None, but models are estimated using aggregated time-series for the entire U.S. banking system.	Utilized a top-down approach to estimate credit loss allowances under CECL methodology. The procyclicality of CECL using this approach is driven by the inaccuracy of forecasts around turning points of the business cycle and not by parameter uncertainty or by not including enough recessions in the estimation of loan loss models.
Craig et al. (2006)	Sources of procyclicality in East Asia financial systems	IL	1960–2004, 10 Asian Countries	None	Delayed recognition of, and provisioning for, nonperforming loans and regulatory forbearance were identified as sources of procyclicality. Banks tend to delay provisioning until the deterioration of loan quality becomes evident during downturns. Stronger banks with high earnings/higher capital ratios tend to provision more, which is consistent with forbearance by weak banks. The provisioning rate was procyclical; growth in GDP, credit, and property prices (i.e., increase in collateral values) lower provisioning. Banks tended to increase provisions when earning are declining or negative, rather than when they are doing well.

Table 1. *Cont.*

Author(s)	Title	Accounting Standards/LLP Regimes Covered	Time Periods, Countries Covered	Consideration of Mergers?	Could Procyclicality Vary Over Business Cycle?
Cummings and Durrani (2016)	Effect of the Basel Accord capital requirements on the loan-loss provisioning practices of Australian banks	IL, IFRS 9	Sep. 2003–Dec. 2012, Australia	None	Bank provisioning behavior has both procyclical and countercyclical characteristics. Provisions and allowances are sensitive to cyclical fluctuations in default risk, however, banks adjust them by including future economic conditions and cushion the impact of cyclical fluctuations through capital and earnings management. The positive relationships between allowances and excess regulatory capital and between allowances and earnings are found. Banks allocate higher allowances when their risk-based capital ratios and earnings are higher than average and adjust them downwards in periods when capital and earnings indicators are weaker.
DeRitis and Zandi (2018)	Gauging CECL cyclicality	IL, ECL(CECL)	1999–2018, US	None, but considers aggregate time-series data.	Considered correlation between LLA and macro variables. Co-movement with aggregate macroeconomic activity; correlation between macro variables and loss reserves; build-up of allowances in good economic times before a recession.
Handorf and Zhu (2016)	US bank loan-loss provisions, economic conditions, and regulatory guidance	IL	1990–2000, US	None	Empirical tests do not support the claim that bank loan loss provisioning is procyclical. After the nondiscretionary component of provisioning practices in controlled for, US banks generally overstate loan-loss provisions during economic expansions.
Laeven and Majnoni (2003)	Loan loss provisioning and economic slowdowns: too much, too late?	IL	1988–1999, 45 countries	None	Find empirical evidence that many banks around the world delay provisioning for bad loans until too late, when cyclical downturns have already set in, thereby magnifying the impact of the economic cycle on banks' income and capital.
Loudis and Ranish (2019)	CECL and the credit cycle	IL, ECL(CECL)	1998–2014, US	Use a merger-adjusted version of the Y-9C that adjusts holding company data only in the quarter that the merger occurs.	Considered fluctuations (standard deviation) in lending growth. Co-movement with aggregate economic activity implies a reduction in lending during downturns and an increase in lending during upturns.

Table 1. *Cont.*

Author(s)	Title	Accounting Standards/LLP Regimes Covered	Time Periods, Countries Covered	Consideration of Mergers?	Could Procyclicality Vary Over Business Cycle?
Wheeler (2019)	Loan loss accounting and procyclical bank lending: the role of direct regulatory actions	IL	1990–2014, quarterly	None	Procyclical lending refers to supply-driven changes in lending that amplify the business cycle in a general discussion in the introduction, but the setup of the empirical analysis only captures co-movement with the business cycle.

Note: Loan loss provisions (LLP), incurred loss (IL), expected credit losses (ECL), current expected credit losses (CECL), International Financial Reporting Standards (IFRS).

Regarding cyclicality, previous studies have taken several different approaches to test for it. Some researchers (e.g., Balasubramanyan et al. 2017; Bikker and Metzemakers 2005; Craig et al. 2006; Cummings and Durrani 2016; DeRitis and Zandi 2018; Wheeler 2019) have considered the correlations between loan loss allowances (and/or provisions) and macroeconomic variables (e.g., gross domestic product growth or property prices) to detect co-movement with the business cycle. Other researchers have focused on delays in the recognition of expected losses (e.g., Balasubramanyan et al. 2017; Beatty and Liao 2011; Berger and Udell 2004) that affect the ability of loan loss reserves to cover credit losses during economic downturns. They typically test for whether longer delays result in greater reductions in recessionary lending compared to smaller delays in loss recognition. Drivers of delay vary but are measured by proxies such as the ratio of loan loss allowances to total nonperforming loans, lagged provisioning, or increases in commercial lending, since the last loan bust. Still other researchers have focused on the discretionary countercyclical aspects of provisioning, such as whether banks with excess capital boost their provisions (e.g., Bikker and Metzemakers 2005; Craig et al. 2006; Cummings and Durrani 2016), and whether banks provision more when their earnings are higher (e.g., Bikker and Metzemakers 2005; Craig et al. 2006; Cummings and Durrani 2016). Taken together, cyclicality of bank provisioning may depend on credit risk measures, excess capital, earnings, and macroeconomic conditions.

Generally, researchers have considered bank provisioning cyclicality using their entire samples. An exception to that approach was Balasubramanyan et al. (2017), who considered whether coefficients in their empirical model were statistically different across a pre-crisis period, a crisis period, and a post-crisis period. We also considered, independently and coincidently, statistical differences across periods to understand whether the determinants of the cyclicality of provisions vary over the business cycle.

Regarding mergers, most bank provisioning studies ignored them. The other studies took a variety of approaches to address mergers: One study dropped observations when purchase accounting mergers occurred (Balasubramanyan et al. 2017), one study trimmed the sample using non-loan asset growth (Beatty and Liao 2011), one study ran their models using only non-merged banks and using their full sample to compare results (Berger and Udell 2004), and another study only merger-adjusted their holding company data in the quarter wherein a merger occurred (Loudis and Ranish 2019). None of these approaches, however, considered the provisioning done by banks that did not survive, but that could be utilized by the acquiring bank during later quarters. This paper seeks to fill this gap by creating a "forced" panel that, for each holding company, incorporates acquired entities in the quarters prior to their mergers.

3. Materials and Methods: Data Description and Empirical Specification

We narrow our attention to a balanced panel of the 25 largest publicly-traded U.S. bank holding companies ranked by total loans and leases held for investment and held for sale (i.e., total loans) as of 2019: Q4 (Table 2).[1] This approach allows us to compare the same entities in different periods of the economic and credit cycle instead of comparing different entities during different phases of these cycles.[2] The total loans held on these bank holding company balance sheets was $5.6 trillion as of year-end 2019, which was more than half the total loans on the books of all insured depository institutions as of that date, which equaled $10.52 trillion according to Federal Deposit Insurance Corporation (2020).

Table 2. U.S. bank holding company sample ranked by total lending.

Name	Ticker	Total Loans [a]
Bank of America Corporation	BAC	1.03
JPMorgan Chase & Co.	JPM	0.99
Wells Fargo & Company	WFC	0.98
Citigroup Inc.	C	0.72
Truist Financial Corporation	TFC	0.31
U.S. Bancorp	USB	0.30
PNC Financial Services Group, Inc., The	PNC	0.24
Citizens Financial Group, Inc.	CFG	0.12
Fifth Third Bancorp	FITB	0.11
Keycorp	KEY	0.10
M&T Bank Corporation	MTB	0.09
Regions Financial Corporation	RF	0.08
Huntington Bancshares Incorporated	HBAN	0.08
Bank of New York Mellon Corporation, The	BK	0.05
Comerica Incorporated	CMA	0.05
New York Community Bancorp, Inc.	NYCB	0.04
Synovus Financial Corp.	SNV	0.04
East West Bancorp, Inc.	EWBC	0.03
TCF Financial Corporation	TCF	0.03
SVB Financial Group	SIVB	0.03
First Horizon National Corporation	FHN	0.03
Northern Trust Corporation	NTRS	0.03
Valley National Bancorp	VLY	0.03
First Citizens Bancshares, Inc.	FCNCA	0.03
Texas Capital Bancshares, Inc.	TCBI	0.03
		$5.57

[a] Note: Total loans in 2019: Q4 are reported in trillions.

We consider the largest holding companies for three reasons. First, larger holding companies tend to be subject to heightened investor attention and greater regulatory and supervisory scrutiny, particularly after the passage of the Wall Street Reform and Consumer Protection Act in 2010. Second, publicly traded bank holding companies may provision differently for losses than other bank holding companies, since the Securities and Exchange Commission can question their loan loss accounting decisions. For example, as part of its agreement with the Securities Exchange Commission to obtain approval for its common stock registration statement, SunTrust agreed to restate prior years' financial statements to reduce its loan-loss provisions in each of the three years 1994 through 1996, resulting in a cumulative reduction in its allowance for loan losses of $100 million (see Wall and Koch 2000; Beck and Narayanamoorthy 2013). Third, larger bank holding companies tend to use more sophisticated and accurate credit risk modeling techniques.

As indicated earlier, we consider whether survivor bias may affect the measured sensitivity of provisions and the associated loan loss allowances to credit risk, asset quality, and forward-looking indicators of economic activity over the business cycle in the United States. This is important because the relatively safe bank holding companies may have had relatively low provisions in the pre-crisis period and had sufficient capital to purchase the relatively riskier bank and thrift holding companies that were acquired near failure during the financial crisis. If one ignores the provisions made and loan loss allowances that were built up by the acquired holding companies in the pre-crisis period, one could potentially understate the extent of preparedness for the losses that were booked in the crisis by the acquirers.

One of the key contributions made in this paper is that we created forced merged holding companies (i.e., virtual bank holding companies) that incorporate the balance sheet and income statement information of all holding company entities that have been combined

either through merger or acquisition in prior quarters. This procedure required manual mapping FR Y-9C data items and OTS 1313 data items for each variable considered.[3]

We distinguished between mergers completed using purchase accounting and mergers completed using pooling of interest accounting in the quarter of each merger. As described in English and Nelson (1998), our income data include estimates of the income earned by entities acquired under purchase-accounting rules during the part of the year preceding the date of the merger. This estimate is based on the income reported by the acquired bank for those quarters preceding the merger and includes an estimate of the income earned in the quarter of the merger. This imputation method was not needed for mergers that use pooling of interest accounting or for forcing in the quarters when an actual merger did not occur. As noted in Section 2, some previous studies that have considered the effects of accounting for provisions over the economic cycle dropped entities that use purchase accounting (e.g., Balasubramanyan et al. 2017), whereas other studies only merger-adjusted data in the quarter of the merger using the English and Nelson methodology (e.g., Loudis and Ranish 2019). Neither of those approaches would capture the provisions made by acquired entities in the quarters leading up to a merger or acquisition. Moreover, neither study considered provisioning or loan loss reserves accumulated by thrift holding companies, such as Washington Mutual, before the financial crisis.

Figure 1 provides time-series evidence pertaining to the relationship between loan loss provisions—the accounting adjustments made to loan loss reserves using the IL standard—measured as a percentage of total loans for our sample, and economic growth, measured using the annual growth rate in gross domestic product (GDP). It is evident that the peak loan-loss provisions coincide with the greatest quarterly decline in GDP during these two decades. Handorf and Zhu (2016), who studied this relationship in the 1990s, found the correlation coefficient between the quarterly change in GDP and bank loan-loss provisions as a percentage of total loans was −0.47; in Figure 1 the correlation coefficient is about −0.50, regardless of whether forced merged holding company (i.e., adjusted) data are used or not.

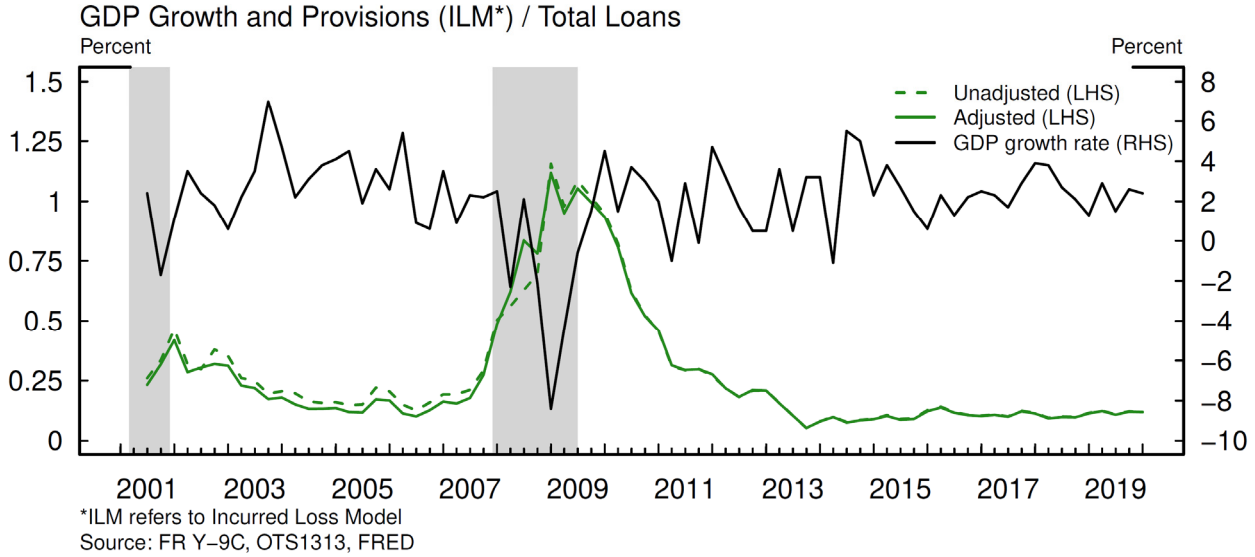

Figure 1. GDP growth compared to loan loss provisions/total loans (2000: Q1–2019: Q4, quarterly data).

While the aggregate differences between adjusted and unadjusted data for provisions relative to total loans may not appear large, such differences could be material for individual holding companies, particularly when a merger occurs between two large entities. Figure 2 provides information on the merger between Wells Fargo & Company (Wells Fargo) and Wachovia Corporation (Wachovia) immediately before and after their mergers

on 31 December 2008. While the dashed lines provide data on the individual entities (Wells Fargo and Wachovia), the solid lines in each panel provide data on a forced merged holding company that adds Wachovia information to that of Wells Fargo prior to the merger.

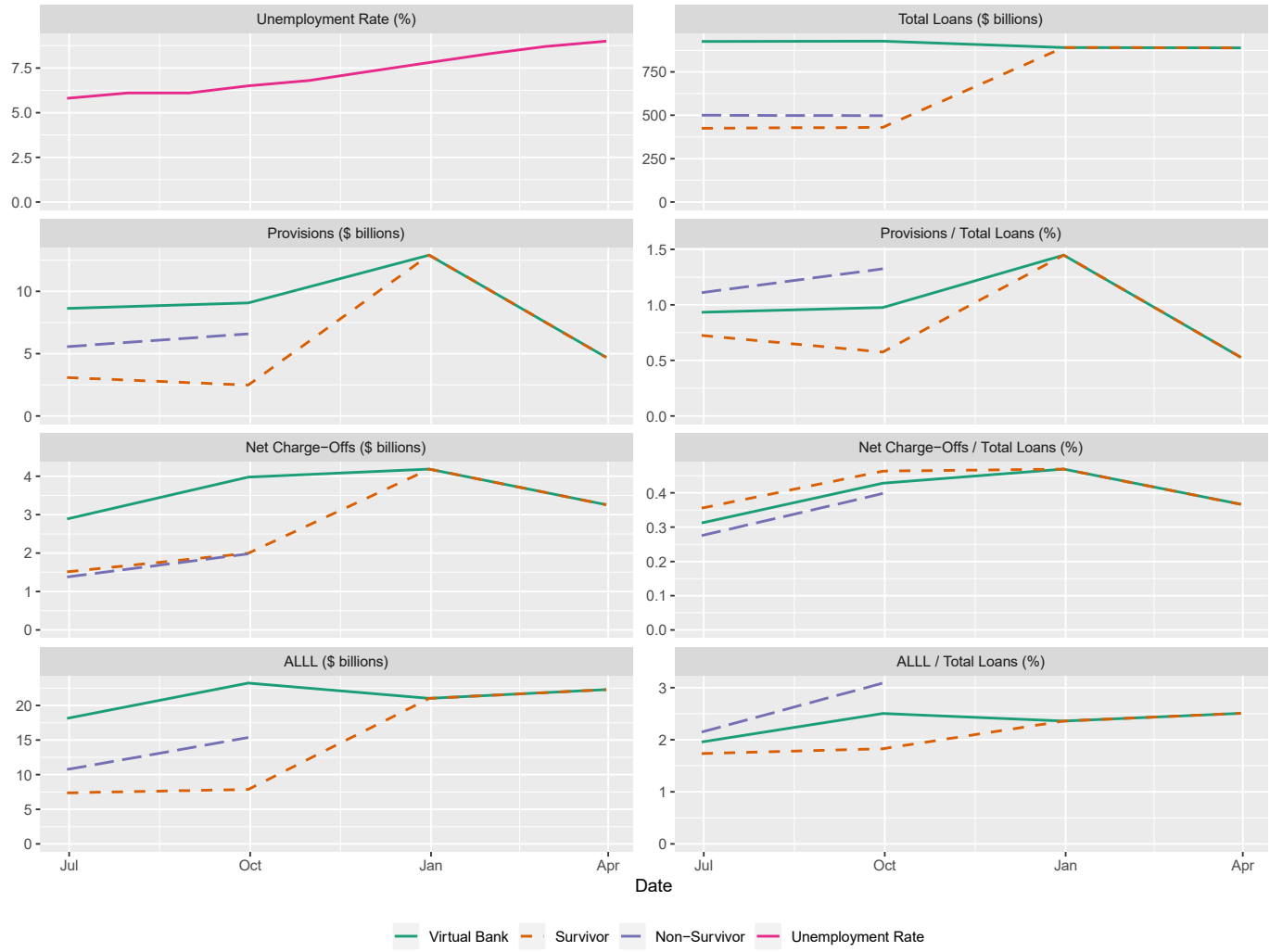

Figure 2. Wells Fargo and Wachovia Merger Adjustment Example.

Notably, the virtual bank has higher absolute provisions and allowances for loan losses prior to the merger than were reported by Wells Fargo. These higher provisions and the associated allowances for the virtual bank are appropriate given that Wells Fargo's loan book in 2009 and later contains loans previously held on Wachovia's balance sheet. Strikingly, the virtual holding company provisions and loan allowances also appear to be flatter prior to the merger compared to the accounting measures that were reported by Wells Fargo. Simply put, it appears that Wells Fargo raised substantial provisions and allowances per dollar of their loan portfolio during the stressed period when solely looking at information as reported by Wells Fargo, but aggregating Wachovia into Wells Fargo prior to the merger shows that the ratios of provision to total loans and loan loss allowance to total loans are much flatter in the stressed period.

Table 3 provides information on the number of mergers during the sample period and the relative size of the acquiring holding companies and the acquired (target) holding companies or acquired (target) thrifts two quarters before the acquisition or merger.[4] Over the entire 2001–2019 period, there were 152 transactions that involved 22 of the 25 bank holding companies in the sample. During the financial crisis there were relatively few

mergers per quarter, but the mean relative size was very large compared to earlier and later periods when the acquirers tended to merge with relatively smaller rivals.

Table 3. Summary Statistics for Merger Adjustments.

Entity Type	Period	Start Quarter	End Quarter	Number of Mergers	Relative Size of Acquiring and Target Holding Companies		
					Mean	Minimum	Maximum
BHC	Pre-crisis	2002: Q1	2007: Q3	54	0.146	0.000	0.644
BHC	Crisis	2007: Q4	2009: Q2	10	0.427	0.020	1.334
BHC	Post-crisis	2009: Q3	2019: Q4	53	0.278	0.010	1.121
Thrift	Pre-crisis	2002: Q1	2007: Q3	9	0.036	0.003	0.081
Thrift	Crisis	2007: Q4	2009: Q2	5	0.085	0.017	0.209
Thrift	Post-crisis	2009: Q3	2019: Q4	9	0.158	0.006	0.666

Note: Bank Holding Companies are denoted by "BHC" and Thrift Holding Companies are denoted by "Thrift".

Turning to our empirical specification, we use a panel regression approach, similar to one used by Cummings and Durrani (2016), to examine the effects of credit risk, capital adequacy and earnings on loan loss provisioning practices for the sample bank holding companies. More specifically, the dollar amount of provisions is regressed on various holding company characteristics including measures of credit risk, risk-based capital ratios before provisions in excess of regulatory requirements, and earnings before provisions and taxes.

The specification of the panel regression is as follows:

$$Y_{it} = \alpha + \beta_1 NPL_{it} + \beta_2 RWAC_{it} + \beta_3 GDPG_{t-1} + \beta_4 LEAD_t + \beta_5 VIXMAX_t + \gamma_1 RCAP_{it} + \gamma_2 EBPT_{it} + \gamma_3 WFUND_{it} + \varepsilon_{it} \quad (1)$$

where subscripts i and t refers to bank holding company i and time t. The dependent variable is either the ratio of provisions to total loans ($PROV_{it}$)[5] or the ratio of allowances for loan and lease losses to total loans ($ALLL_{it}$).[6] The independent variables are:

- NPL_{it} is nonperforming loans[7] divided by total loans,
- $RWAC_{it}$ is the ratio of risk-weighted assets for credit risk to total loans,[8]
- $GDPG_{t-1}$ is lagged real gross domestic product (GDP)[9] growth, which is measured as an annual percent change based on seasonally adjusted information,
- $LEAD_t$ is the quarterly average of monthly values for the Leading Index with a measure of aggregate economic activities for the United States, also measured on a seasonally adjusted basis,[10]
- $VIXMAX_t$ is the maximum value within each quarter of the Chicago Board Options Exchange's CBOE Volatility Index, VIX, which is a measure of the stock market's expectation of volatility that is based on S&P 500 index options,
- $RCAP_{it}$ is the sum of actual tier 1 capital and the allowance for loan and lease loans divided by risk-weighted assets[11] minus the required tier 1 risk-based capital ratio set for the bank holding company by the Federal Reserve (a size of tier 1 capital buffer above the minimum regulatory capital requirement),
- $EBPT_{it}$ is earnings before provisions and taxes divided by average assets,[12] and
- $WFUND_{it}$ is wholesale funding divided by total loans.[13]

In addition, bank-specific intercepts (not shown) capture any unobserved bank effects not included in the model (e.g., degrees of sectoral or geographic concentration, or different business models). All *t*-statistics are adjusted for cross-sectional and time-series dependence in the regression residuals by clustering the standard errors at both the bank and quarter levels (as suggested by Thompson 2011).[14]

As our focus on whether the sensitivity of provisions and the associated loan loss allowances to the factors varies across boom and bust periods, we stratify our sample into three periods: pre-crisis (2002: Q1–2007: Q3; credit boom), crisis (2007: Q4–2009: Q2; credit bust), and post-crisis (2009: Q3–2019: Q4; credit boom) based on NBER U.S. business cycles. This sample period runs from the quarter after the end of the recession following the dotcom bubble to the quarter before the scheduled implementation of a new accounting standard, the current expected credit loss standard. We create forced merged bank holding companies (i.e., "virtual bank holding companies") first and then split the sample into the pre-crisis, crisis, and post-crisis subsamples. We estimate the provisions and loan loss allowances specifications using the forced merged holding companies data (i.e., adjusted data) and using the reported information for the surviving banks as of the end of the estimation period (i.e., unadjusted data).

Summary statistics—mean, standard deviation (SD), minimum (Min), median, and maximum (Max)—are provided in Table 4 for each variable used in our specifications for each of the three periods under consideration. Panel A provides these statistics using "as reported" (i.e., unadjusted) Call Report Y9C data for the 25 bank holding companies in our sample. Panel B provides summary statistics for the forced merged holding companies (i.e., adjusted) data. The bottom panel, panel C, provides summary statistics for the macroeconomic variables used in both specifications.

Table 4. Summary Statistics.

Variable	Period	Mean	SD	Min	Median	Max
			Panel A: Call Report Variables			
$PROV_{it}$	Pre-crisis	0.001	0.001	−0.008	0.001	0.012
	Crisis	0.005	0.005	0.000	0.004	0.028
	Post-crisis	0.002	0.002	−0.002	0.001	0.024
$ALLL_{it}$	Pre-crisis	0.013	0.005	0.004	0.013	0.035
	Crisis	0.017	0.009	0.004	0.016	0.053
	Post-crisis	0.016	0.010	0.002	0.013	0.065
NPL_{it}	Pre-crisis	0.008	0.005	0.000	0.007	0.030
	Crisis	0.021	0.015	0.001	0.017	0.065
	Post-crisis	0.020	0.017	0.001	0.014	0.080
$RWAC_{it}$	Pre-crisis	1.317	0.295	0.775	1.210	2.458
	Crisis	1.326	0.344	0.916	1.213	3.019
	Post-crisis	1.324	0.390	0.782	1.207	3.201
$WFUND_{it}$	Pre-crisis	0.165	0.175	0.004	0.102	0.898
	Crisis	0.182	0.147	0.015	0.129	0.642
	Post-crisis	0.119	0.134	0.000	0.068	0.662
$RCAP_{it}$	Pre-crisis	0.049	0.023	0.019	0.040	0.136
	Crisis	0.056	0.025	0.015	0.049	0.137
	Post-crisis	0.063	0.024	0.011	0.061	0.153
$EBPT_{it}$	Pre-crisis	0.006	0.002	−0.010	0.006	0.024
	Crisis	0.003	0.006	−0.044	0.004	0.021
	Post-crisis	0.004	0.002	−0.018	0.004	0.031
			Panel B: Call Report Variables (Adjusted for Mergers)			
$PROV_{it}$	Pre-crisis	0.001	0.001	−0.008	0.001	0.010
	Crisis	0.006	0.004	0.000	0.004	0.025
	Post-crisis	0.002	0.002	−0.001	0.001	0.019
$ALLL_{it}$	Pre-crisis	0.013	0.004	0.006	0.012	0.035
	Crisis	0.017	0.008	0.006	0.015	0.052
	Post-crisis	0.016	0.009	0.002	0.013	0.064
NPL_{it}	Pre-crisis	0.008	0.004	0.001	0.007	0.029
	Crisis	0.022	0.014	0.001	0.020	0.059
	Post-crisis	0.021	0.017	0.001	0.014	0.080

Table 4. *Cont.*

Variable	Period	Mean	SD	Min	Median	Max
Panel B: Call Report Variables (Adjusted for Mergers)						
$RWAC_{it}$	Pre-crisis	1.281	0.294	0.760	1.186	2.482
	Crisis	1.295	0.341	0.876	1.195	3.019
	Post-crisis	1.312	0.397	0.800	1.184	3.201
$WFUND_{it}$	Pre-crisis	0.151	0.134	0.004	0.112	0.780
	Crisis	0.172	0.137	0.015	0.130	0.642
	Post-crisis	0.120	0.133	0.000	0.071	0.662
$RCAP_{it}$	Pre-crisis	0.048	0.016	0.020	0.043	0.136
	Crisis	0.055	0.020	0.017	0.053	0.118
	Post-crisis	0.064	0.024	0.011	0.063	0.146
$EBPT_{it}$	Pre-crisis	0.006	0.002	−0.010	0.006	0.015
	Crisis	0.003	0.005	−0.038	0.003	0.019
	Post-crisis	0.004	0.002	−0.018	0.004	0.029
Panel C: Macroeconomic Variables						
$GDPG_{t-1}$	Pre-crisis	2.878	1.630	0.60	2.600	7.000
	Crisis	−1.486	4.076	−8.40	−2.100	2.500
	Post-crisis	2.257	1.545	−1.10	2.300	5.500
$LEAD_t$	Pre-crisis	1.155	0.403	0.43	1.213	1.683
	Crisis	−0.757	1.088	−2.42	−0.600	0.430
	Post-crisis	1.456	0.376	0.01	1.517	1.933
$VIXMAX_t$	Pre-crisis	23.016	8.690	12.67	19.960	45.080
	Crisis	44.851	19.253	24.12	42.280	80.860
	Post-crisis	25.046	8.634	13.12	22.850	48.000

4. Results: The Effects of Credit Risk, Capital Adequacy, Earnings and the Economic Cycle on Bank Provisioning and Loan Loss Allowances

The regression results for the provisioning specification are presented in Table 5 for the three periods considered—pre-crisis (2002: Q1–2007: Q3), crisis (2007: Q4–2009: Q2), and post-crisis (2009: Q3–2019: Q4)—estimated using data from the largest 25 U.S. bank holding companies ranked by total loans in 2019: Q4 using reported data (see columns (1), (3), and (5)) each labeled (unadjusted)) and with forced merged holding company adjustments (see columns (2), (4), and (6) each labeled (adjusted)). For all factors included in our specification for provisioning, the within-period differences between unadjusted and adjusted coefficients are statistically insignificant at the 10 percent confidence level or less using standard *t*-tests (see Tables A1–A3 in Appendix A).

Nonperforming loans are a harbinger for higher expected loan losses; therefore, it was expected that the coefficients on NPL_{it} would be positive and significant at a five percent level or better for all periods considered. The impact of nonperforming loans on provisioning behavior appears to differ across the economic cycle. As foreshadowed in Figure 1, the provisioning rate corresponding to the same percentage of nonperforming loans appears to be higher during the 2008 economic downturn (0.195 (0.152) using unadjusted (adjusted) data), than it is in the pre-crisis period (0.121 (0.127) using unadjusted (adjusted) data) and in the post-crisis period (0.085 (0.079) using unadjusted (adjusted) data).

Where forced merger-adjustments make a difference is in cross period considerations of the sensitivity of provisioning to nonperforming loans. More specifically, using *t*-tests to consider statistical differences in coefficients across periods (see Tables A4–A9 in Appendix A), the coefficient for nonperforming loans is significantly larger at the five percent level when we compare the pre-crisis coefficient to the post-crisis coefficient using adjusted data; however, the coefficient of nonperforming loans is significantly larger at the five percent level when we compare the crisis coefficient to the post-crisis coefficient using unadjusted data. All other cross-period differences in coefficients on nonperforming loans reported in Table 5 are statistically insignificant with confidence levels at or less than 10 percent. Of the three periods considered, our findings provide some evidence for the

view that the provisioning rate is lowest in the post-crisis period, a period when the largest bank holding companies shifted their focus towards meeting higher post-crisis regulatory capital requirements.

Table 5. How do U.S. Bank Holding Company Provisions Vary over the Business Cycle?

Explanatory Variable	*Dependent Variable*: $PROV_{it}$					
	Pre-Crisis	**Pre-Crisis (Adjusted)**	**Crisis**	**Crisis (Adjusted)**	**Post-Crisis**	**Post-Crisis (Adjusted)**
	(1)	(2)	(3)	(4)	(5)	(6)
NPL_{it}	0.121 *** (0.024)	0.127 *** (0.018)	0.195 *** (0.054)	0.152 ** (0.065)	0.085 *** (0.018)	0.079 *** (0.016)
$RWAC_{it}$	−0.001 (0.001)	−0.001 (0.001)	−0.001 (0.002)	−0.003 (0.003)	−0.0003 (0.001)	−0.0003 (0.001)
$WFUND_{it}$	0.001 (0.001)	0.001 (0.001)	0.007** (0.003)	0.004 (0.005)	0.001 (0.003)	0.001 (0.003)
$RCAP_{it}$	−0.013 *** (0.005)	−0.012 ** (0.006)	0.021 (0.020)	0.050 ** (0.025)	−0.005 (0.004)	−0.001 (0.004)
$EBPT_{it}$	0.126 (0.089)	0.177 * (0.106)	−0.067 (0.082)	−0.115 * (0.062)	−0.020 (0.037)	−0.020 (0.025)
$GDPG_{t-1}$	−0.005 *** (0.002)	−0.004 *** (0.001)	−0.019 *** (0.007)	−0.010 (0.013)	0.005 (0.005)	0.005 (0.005)
$LEAD_t$	0.002 (0.013)	−0.012 (0.011)	0.172 ** (0.086)	0.140 (0.094)	−0.268 *** (0.043)	−0.277 *** (0.042)
$VIXMAX_t$	0.00003 *** (0.00001)	0.00002 ** (0.00001)	0.0001 ** (0.00004)	0.0001 * (0.00003)	0.00001 (0.00001)	0.00001 (0.00001)
Force Merged Adjusted?	*N*	*Y*	*N*	*Y*	*N*	*Y*
Bank Fixed Effects?	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*
No. Banks	25	25	25	25	25	25
Observations	575	575	175	175	1050	1050
R^2	0.346	0.421	0.481	0.429	0.652	0.688
Adjusted R^2	0.307	0.387	0.364	0.300	0.641	0.678

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Our second credit risk measure, the ratio of risk-weighted assets to total loans, RWA_{it}, was not statistically significant in any of the three periods considered, regardless of whether the data were adjusted or unadjusted.

One hypothesis is that banks that fund a greater proportion of their loan books with wholesale borrowings will have significantly higher provisions because of the greater scrutiny of their provisions from market investors. We found some support for this hypothesis during the crisis period for large U.S. bank holding companies, as the coefficient for $WFUND_{it}$ is positive and significant at the 5 percent level in that period, and this coefficient is significantly different across periods when we use unadjusted data.[15] However, the significance of wholesale funding and the related statistical difference across periods for its effect on provisioning evaporates when we use the forced merged (adjusted) holding company data and a 10 percent or smaller confidence level.

In the pre-crisis period, there is a significantly negative coefficient (at the five percent level or less) on the difference between the actual tier 1 risk-based capital ratio and the required tier 1 risk-based capital ratio, $RCAP_{it}$, regardless of whether the data are adjusted or not. This finding is consistent with the capital management hypothesis, which claims that low capital banks use loan loss provisions to boost their capital (see Ahmed et al. 1999;

Pérez et al. 2008). In general, a bank with a minimal capital buffer may indicate a struggle or a problem that the bank faces heightened losses including loan losses that need larger provisions to cover them.

In contrast, the coefficient for $RCAP_{it}$ during the crisis period is positive and statistically significant at the five percent confidence level using the forced merged (adjusted) data, which is consistent with low capital banks reducing provisions to ensure adequate regulatory capital or, alternatively, higher income (see Kim and Kross 1998; Cummings and Durrani 2016).

In the post-crisis period, the coefficient for $RCAP_{it}$ was insignificant even at the 10 percent confidence level. This is an important finding because regulators not only strengthened bank holding company capital requirements (especially for Common Equity Tier 1 and Tier1 capital requirements), but also employed stress testing exercises to examine U.S. bank holding companies' capital plans and capital distributions during the post-crisis period. These changes in the regulatory and supervisory regime appear to have changed bankers' loan loss provisioning behavior during this period.

Using *t*-tests to consider statistical differences in coefficients across periods, the coefficients on $RCAP_{it}$ are statistically different across the pre-crisis and crisis periods at the 5 percent level and across the pre-crisis and post-crisis periods at the 10 percent level when unadjusted holding company data are employed. However, the coefficients on $RCAP_{it}$ are statistically different across all three periods considered—at a 10 percent confidence level or smaller—when forced merged (adjusted) data are utilized.[16] This difference in significance levels across periods is important when considering the differences in provisioning across the boom and bust periods.

Considering the coefficients on earnings before provisions and taxes, $EBPT_{it}$, it is apparent that this factor is only significant, and only at the 10 percent confidence level, in the two early periods when the bank holding company data are force merged (i.e., adjusted). In the pre-crisis period, the positive coefficient is consistent with bank holding companies provisioning more when their earnings are higher, a consistent finding with Beatty and Liao (2011). The negative coefficient for $EBPT_{it}$ during the crisis period, however, suggests that bank holding companies provisioned less to preserve higher earnings. To the extent that lower relative earnings in the crisis period was the consequence of having taken on greater risks in the pre-crisis period, such higher provisions during the crisis were no doubt warranted.

Macroeconomic conditions past and future are measured using lagged real GDP growth, $GDPG_{t-1}$, and the quarterly average of monthly values for the Leading Index for the United States, $LEAD_t$, respectively. During the pre-crisis period, the coefficient on $GDPG_{t-1}$ is expected to be negative—it is of the expected sign and it is significant at the one percent confidence level—since credit losses are likely to be lower in a robust macroeconomic environment. The coefficient for $LEAD_t$ is not statistically significant at the 10 percent confidence level or less, regardless of whether the holding company data are force merged (adjusted) or not (unadjusted).

In contrast, during the crisis period, the coefficient for $GDPG_{t-1}$ is of the expected sign and statistically significant at the one percent confidence level only when unadjusted holding company data are used.[17] The coefficient for GDP growth is expected to be negative, since credit losses are likely to be higher in a deteriorating macroeconomic environment. In contrast, the coefficient for the leading index $LEAD_t$ is positive for unadjusted data, an unexpected sign. However, when holding company data are force merged (adjusted), neither of these macroeconomic coefficients are statistically significant even at the ten percent confidence level during the crisis period.[18] Taken together, these findings suggest that perceptions about the procyclicality of provisions during the great financial crisis may have resulted from observers not taking into account the provisions that had been accumulated by the acquired, and in many cases unsuccessful, target bank holding companies (see Figure 2).

During the post-crisis period, the coefficient for $GDPG_{t-1}$ is not statistically significant at the 10 percent confidence level, regardless of whether the holding company are force merged (adjusted) or not (unadjusted). In contrast, the coefficient for $LEAD_t$ is negative and statistically significant at the one percent confidence level during this period. A negative coefficient for the leading index is consistent with bank holding companies reducing provisions when the outlook for lending activity is improving. An examination of the data in Figure 1 indicates that provisioning by large U.S. holding companies declined substantially in the immediate aftermath of the crisis; this was a period when the leading indicator rose substantially. Then, both the provisioning and the leading indicator time-series were fairly flat for the remainder of the post-crisis period. In light of these time-series, the negative coefficient of the leading index reflects the fact that it took some time to work through troubled loans on U.S. holding company books in the immediate aftermath of the global financial crisis. As aforementioned, this is the period when loan loss provisioning behavior changed after more stringent regulatory capital requirements were implemented and imposed.[19]

The last row of coefficients reported in Table 5 contains coefficients on the maximum value within each quarter of the CBOE Volatility Index, $VIXMAX_t$. These coefficients are positive and statistically significant during the pre-crisis and crisis periods, which is consistent with bank holding company managers strengthening their provisioning when uncertainty about market conditions increases.[20] This finding is robust to whether or not the holding company data are force merged (adjusted) in these periods.[21] That said, volatility did not appear to affect provisioning in the post-crisis era, a period during which volatility by this measure remained subdued.

In general, our findings do not support the view that provisioning was more stringent during the crisis period compared to the pre-crisis period. The sensitivity of provisioning to nonperforming loans was not significantly different across these periods despite the larger reported coefficient in the crisis period (see Tables A4 and A7)[22]. Moreover, statistical differences in the sensitivity of provisioning to recent real GDP growth across these periods is simply a consequence of not appropriately accounting for the mergers that occurred between weaker and stronger rivals.

Furthermore, the results using the force merged (adjusted) holding company data are not consistent with provisioning being less stringent in the post-crisis period compared to the crisis period. While it appears that the sensitivity to nonperforming loans declined after the crisis, the difference in coefficients on NPL_{it} is not statistically significant even at the 10 percent confidence level when using force-merged holding company data (see Table A9 in Appendix A). Moreover, there is no statistical difference in the sensitivity of provisioning to recent real GDP growth when the adjusted data are used. Indeed, statistical differences in the sensitivities of provisioning to nonperforming loans and to recent real GDP growth across the crisis and post-crisis periods are once again simply a consequence of not accounting for the mergers that occurred between weaker and stronger rivals during the 2008 global financial crisis.

Table 6 reports results examining the drivers of large U.S. holding company allowances for loan and lease losses $ALLL_{it}$) over time. As was the case with the specification for provisioning, results for differences in coefficients within each period using the unadjusted and adjusted holding company data were not significant even at the 10 percent level of confidence for any of the factors considered (see Tables A10–A12 in Appendix B). Results of differences in coefficients across periods, however, were significant for some factors (see Tables A13–A18 in Appendix B).

Table 6. How do U.S. bank holding company loan loss allowances vary over the business cycle?

Explanatory Variable	*Dependent Variable*: $ALLL_{it}$					
	Pre-Crisis	**Pre-Crisis (Adjusted)**	**Crisis**	**Crisis (Adjusted)**	**Post-Crisis**	**Post-Crisis (Adjusted)**
	(1)	(2)	(3)	(4)	(5)	(6)
NPL_{it}	0.477 *** (0.107)	0.636 *** (0.091)	0.315 *** (0.060)	0.325 *** (0.051)	0.377 *** (0.039)	0.390 *** (0.035)
$RWAC_{it}$	0.008 ** (0.004)	0.007 * (0.004)	−0.003 (0.002)	−0.002 (0.002)	0.004 (0.004)	0.001 (0.004)
$WFUND_{it}$	−0.003 (0.002)	−0.001 (0.002)	0.006 (0.005)	0.012 * (0.007)	0.016 (0.010)	0.019 * (0.010)
$RCAP_{it}$	0.107 *** (0.039)	0.110 *** (0.038)	0.149 *** (0.037)	0.149 *** (0.032)	0.059 ** (0.030)	0.021 (0.025)
$EBPT_{it}$	−0.130 (0.140)	−0.174 (0.166)	0.050 (0.053)	0.024 (0.061)	−0.388 ** (0.184)	−0.258 * (0.152)
$GDPG_{t-1}$	0.008 (0.015)	0.007 (0.011)	0.019 ** (0.008)	0.026 * (0.015)	0.008 (0.005)	0.008 * (0.005)
$LEAD_{t}$	0.100 (0.105)	0.103 (0.091)	−0.063 (0.054)	−0.086 (0.085)	−0.191 *** (0.072)	−0.181 *** (0.065)
$VIXMAX_{t}$	0.0001 *** (0.00003)	0.0001 ** (0.00002)	−0.00003 * (0.00002)	−0.00004 ** (0.00002)	0.0001 *** (0.00002)	0.00005 *** (0.00002)
Force Merged Adjusted?	*N*	*Y*	*N*	*Y*	*N*	*Y*
Bank Fixed Effects?	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*
No. Banks	25	25	25	25	25	25
Observations	575	575	175	175	1050	1050
R^2	0.605	0.675	0.859	0.846	0.787	0.805
Adjusted R^2	0.582	0.656	0.828	0.812	0.780	0.798

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

The coefficients on nonperforming loans are of the expected positive sign and are statistically significant at the one percent confidence level, regardless of the period considered or whether unadjusted or adjusted holding company are used in estimation. The larger positive coefficients during the pre-crisis period are consistent with allowances being built up in a credit boom and the significantly lower coefficients in the crisis period are consistent with allowances being drawn down in a credit bust.

While the pre-crisis coefficient for nonperforming loans, 0.447, is statistically larger than the crisis coefficient, 0.315, at the 10 percent level of confidence when using unadjusted bank holding company data, the larger coefficient for nonperforming loans in the pre-crisis period, 0.636, is significantly larger than the crisis coefficient, 0.325, and the post-crisis coefficient, 0.390, at the one percent confidence level when forced merged (adjusted) bank holding company data are used (see Appendix B). Therefore, taking into account loan allowances built up in the pre-crisis period by (riskier) entities that eventually merged with (safer) entities is important for explaining the significantly lower loan loss allowance rates that were taken by the largest U.S. holding companies during the crisis and post-crisis periods.

From this view, the second credit risk measure—the ratio of risk-weighted assets for credit risk to total loans, $RWAC_{it}$—is only a significant driver of loan allowances in the pre-crisis period.[23] Cummings and Durrani (2016), who used data on Australian banks, also reported insignificant coefficients for this variable when they considered this effect on provisioning.

A greater reliance on wholesale funding significantly boosts loan loss allowances during the crisis and post-crisis periods, but this effect is not detectable unless force merged (adjusted) data are used together with a 10 percent confidence threshold. Nevertheless, when using our force merged (adjusted) holding company data, the coefficients for $WFUND_{it}$ are statistically different in both of these periods at the five percent confidence level.

For the pre-crisis and the crisis periods, there are significantly positive coefficients (at the one percent level) for $RCAP_{it}$, and the tier 1 risk-based capital buffer exceeds the minimum regulatory requirement of tier 1 risk-based capital, regardless of whether the data are forced merged (adjusted) or not (unadjusted). This finding is consistent with the bank performance hypothesis, which indicates that a strong bank manages its capital and loan loss allowance with a sufficient buffer, while a weak bank struggles to barely meet the minimums for both its capital and loan allowance. This finding is also consistent with surplus capital being used both to increase provisions to directly fund short-term credit losses and to increase specific provisions for medium to longer-term credit losses through general provisions (see Cummings and Durrani 2016).[24]

In the post-crisis period, the coefficient for $RCAP_{it}$ is significant at the 5 percent confidence level for unadjusted data but insignificant for adjusted data (though the positive coefficient remains). In this period, the estimates of coefficients are much smaller, less than a half of those of the estimates in pre-crisis and crisis periods. This finding confirms our finding that the more stringent regulatory capital requirement and the stress testing environment after the financial crisis changed bank behavior with respect to capital and loan loss provisioning management.

Earnings before provisions and taxes, $EBPT_{it}$, significantly affected loan allowances taken by the largest U.S. holding companies only in the post-crisis period, albeit at only the 10 percent confidence level when the holding company data are forced merged (i.e., adjusted). The negative coefficient for this factor is not consistent with the earnings management hypothesis that bank managers have an incentive to smooth earnings. The finding that bank holding companies with relatively low earnings during the post-crisis period have had relatively high loan loss allowances may be related to supervisory stress testing, where the appropriate level of allowances for loan and lease losses ($ALLL_{stress}$) at the end of a given quarter is the amount needed to cover projected loan losses over the next four quarters under a severely adverse scenario (Board of Governors of the Federal Reserve System 2018). To the extent that the bank holding company's estimate of probable incurred losses, ALLL, is informed by $ALLL_{stress}$, the holding company's adjustments to ALLL could be spread out over the planning horizon to smooth its effect on capital. Such potential adjustments would be consistent with the observed negative relationship between earnings before provisions and taxes and loan loss allowances during the post-crisis period.

Consistently with the results reported in Gray (2004), the coefficients on lagged economic growth, $GDPG_{t-1}$, in the loan loss allowances specification are positive and significant at the 10 percent confidence level or less during the crisis and post-crisis periods.[25] Using bank holding company data from 1999–2003, Gray found real economic growth positively affected the allowances for loan losses reported by the largest banks in his sample; he argued that such banks were more likely to have nationwide operations and be affected by the overall U.S. economy, unlike smaller bank holding companies that would more likely be dependent on the local economy. This finding is also consistent with holding companies building up allowances during credit booms and drawing them down in credit busts. Notably, this finding is not detectable in the pre-crisis period or when using unadjusted data during the post-crisis period.

The negative and significant coefficient for the leading indicator, $LEAD_t$, in the specification for loan loss allowances during the post-crisis period (Table 6) is consistent with the negative and significant coefficient for this indicator in our provisioning specification (Table 5). As described earlier, this finding likely reflects the fact that net loan charge-offs reached the peak in 2010, after the great financial crisis that drove down allowances. In other words, it took time to work through troubled loans on bank holding company books in the immediate aftermath of the global financial crisis. This finding also likely reflects that bank holding companies have shifted their focus towards compliance with elevated regulatory and stressed capital requirements during the post-crisis period, under which bigger allowances would reduce capital. Moreover, it likely supports the hypothesis that as economic conditions improve in the not-too-distant future, provisions decline as bankers revise downward their expected losses; loan loss allowances decline accordingly.

The significantly positive volatility effect on loan loss allowances in the pre-crisis period (Table 6) is consistent with the significant positive volatility effect on provisioning during that period (Table 5). During the crisis period, however, volatility significantly increased provisions (Table 5), but not enough to boost loan loss allowances (Table 6). During this period, loan charge-offs drained loss reserves faster, which were significantly negatively affected by volatility using a 10 percent confidence level or better, regardless of whether or not the bank holding company data were force merged (i.e., adjusted).

Recall that the level of the allowance for loan and lease losses (ALLL) is determined by both loan loss provisions and charge-offs. Although the provisions increased promptly during the crisis period, banks' charge-offs still reflected the level observed during the pre-crisis period (i.e., charge-offs were relatively low). Conversely, volatility significantly and positively affected loan loss allowances (at the one percent confidence level) even though the volatility effect on provisions was not statistically detectable (at the 10 percent confidence level). Looking across periods, the coefficient for our volatility measure was statistically different across the pre-crisis and crisis periods and across the crisis and post-crisis periods at the one percent confidence level, regardless of whether the forced merged (adjusted), or unadjusted data were used for *t*-tests.

5. Conclusions

In this paper, we revisited whether the incurred loss (IL) standard as implemented by large U.S. bank holding companies has been procyclical using regulatory reports filed over the last two decades. Unlike previous studies, we considered whether "survivor bias" may have exaggerated researchers, policymakers, and bankers' views on the procyclicality of the IL standard. To understand potential survivor bias, we (1) created a "forced panel," which incorporates information from the entities that did not survive, and an "as reported panel" for the largest 25 surviving U.S. bank holding companies as of year-end 2019; (2) used standard empirical models that test the extent to which provisions and the associated loan loss allowances are influenced by credit risk, asset quality, the current state of the business cycle, and forward-looking indicators; (3) considered three separate cyclical periods (pre-crisis, crisis, and post-crisis periods); and (4) tested for whether coefficients in the models vary across panel types (i.e., "forced" and "as reported" panels) and across cyclical periods.

We found a positive and statistically larger effect of nonperforming loans on U.S. bank holding company allowances for loan and lease losses in the pre-crisis period compared to the crisis period when subsequent mergers were considered, because much of the increase in allowances was built up by the riskier holding companies that did not survive the crisis. These actions reduced capital and depressed lending in the pre-crisis boom period; such actions with *countercyclical* impacts would be consistent with the envisioned macroprudential policies of regulators that were developed in the aftermath of the crisis. Moreover, the sensitivity of allowances to lagged economic growth across the pre-crisis and crisis periods is consistent with allowances being built up in the credit boom and drawn down in the credit bust once survivorship bias is accounted for; this observed relationship

over the economic cycle is consistent with one of the rationales put forth for the recently adopted expected loss standards (see, for example, Cohen and Edwards 2017).

During the 2008 financial crisis, loan losses were likely higher than bankers expected because the economic downturn was much more severe than business downturns in their recent experience; the loan loss allowances built up earlier were insufficient. As loan quality deteriorated, the rate of provisioning used by banks is estimated to be a constant fraction of their nonperforming loans when compared to the earlier period. However, these actions appear to have had *procyclical* impacts, as higher provisioning increased loans loss allowances, reduced capital, and depressed lending. This finding is one reason why it is important to consider provisioning behavior in a credit boom and a credit bust separately when one considers the cyclicality of provisioning and the associated loan loss allowances. Moreover, it is essential to also recognize that bankers' best expectations are not the same as perfect foresight. Errors in expectations can result in (unexpected) lending procyclicality with concomitant financial stability implications.

One thing we could not control for but that may be important for the cyclicality of bank provisioning and loan loss allowances is whether the risk management capabilities differed across the acquired and surviving banks. To be sure, ex post the acquired banks should have provisioned more and built up their loan loss allowance more than they did, but surviving banks appear to also be deficient in their provisioning during the pre-crisis period ex post. Unfortunately, we could not distinguish between survivorship bias and risk management ability differences across the acquired and surviving banks.

Whether one believes that the risk management abilities of bankers at eventually acquired banks were lacking or not, our finding that bankers, even the unsuccessful ones, built up allowances in the pre-crisis period to draw them down in the credit bust suggests that the introduction of an expected loss standard could have only modest impacts on the need to provision during a future crisis and on the resulting curtailment of lending due to capital constraints. In contrast, research using aggregate time-series or "as reported" panel data would suggest a substantial reduction in the procyclicality of provisioning and loan loss allowances with the introduction of expected loss standards (see, for example, Cohen and Edwards (2017) and Du et al.'s discussion in Basel Committee on Banking Supervision (2021)).

Our findings that tier 1 risk-based capital buffers over required minimums significantly (and positively) influenced provisioning and loan loss allowances in both the pre-crisis and crisis periods are consistent with the findings of other researchers who have considered the performance management hypothesis (i.e., bankers allocate part of their capital above regulatory requirements to pre-fund future credit losses through provisions). For the post-crisis period, some researchers have found support for this hypothesis, but we only found support for it when we did not account for survivor bias by using our force merged bank holding company panel. As a result, policymakers could be misled about the potential effects of more stringent regulatory capital requirements—for example, larger capital conservation buffers or the introduction of countercyclical capital ratios—on the cyclicality of bank provisioning behavior and its effects on bank lending over the credit and economic cycles.

Looking forward, our findings suggest that future researchers should consider the provisioning and loan loss allowances of entities that are eventually merged with or acquired by other bank holding companies when they empirically analyze the effects of accounting loss standards, including the recently implemented expected loss accounting standards, on the cyclicality of provisioning or loan loss allowances, on the cyclicality of bank lending, and on financial stability. Moreover, the material and statistically significant drivers of bank provisioning and loan loss allowance cyclicality seem to change over the credit boom-and-bust cycle, or over the economic cycle. To some extent, differences over the business cycle in the importance of certain drivers may be driven by the inherent difficulties in estimating expected credit losses. The expected credit losses associated with coronavirus

pandemic, for example, were not anticipated in advance, much like the loan losses due to the Great Recession were not anticipated.

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Appendix A. Testing Coefficient Differences from Provision Regressions

Table A1. Comparison of pre-crisis (1) and pre-crisis (adjusted) (2).

Variable	Model1_ Coefficient	SE	Model2_ Coefficient	SE	*t*-Statistic	*p*-Value
NPL_{it}	0.121	0.024	0.127	0.018	−0.197	0.422
$RWAC_{it}$	−0.001	0.001	−0.001	0.001	−0.130	0.448
$WFUND_{it}$	0.001	0.001	0.001	0.001	−0.213	0.416
$RCAP_{it}$	−0.013	0.005	−0.012	0.006	−0.121	0.452
$EBPT_{it}$	0.126	0.089	0.177	0.106	−0.367	0.357
$GDPG_{t-1}$	−0.005	0.002	−0.004	0.001	−0.708	0.240
$LEAD_t$	0.002	0.013	−0.012	0.011	0.821	0.206
$VIXMAX_t$	0.000	0.000	0.000	0.000	0.541	0.294

Table A2. Comparison of crisis (3) and crisis (adjusted) (4).

Variable	Model1_ Coefficient	SE	Model2_ Coefficient	SE	*T*-Statistic	*p*-Value
NPL_{it}	0.195	0.054	0.152	0.065	0.506	0.307
$RWAC_{it}$	−0.001	0.002	−0.003	0.003	0.385	0.350
$WFUND_{it}$	0.007	0.003	0.004	0.005	0.394	0.347
$RCAP_{it}$	0.021	0.020	0.050	0.025	−0.924	0.179
$EBPT_{it}$	−0.067	0.082	−0.115	0.062	0.468	0.320
$GDPG_{t-1}$	−0.019	0.007	−0.010	0.013	−0.653	0.257
$LEAD_t$	0.172	0.086	0.140	0.094	0.256	0.399
$VIXMAX_t$	0.000	0.000	0.000	0.000	0.467	0.321

Table A3. Comparison of post-crisis (5) and post-crisis (adjusted) (6).

Variable	Model1_ Coefficient	SE	Model2_ Coefficient	SE	*t*-Statistic	*p*-Value
NPL_{it}	0.085	0.018	0.079	0.016	0.239	0.405
$RWAC_{it}$	0.000	0.001	0.000	0.001	−0.052	0.479
$WFUND_{it}$	0.001	0.003	0.001	0.003	−0.036	0.485
$RCAP_{it}$	−0.005	0.004	−0.001	0.004	−0.565	0.286
$EBPT_{it}$	−0.020	0.037	−0.020	0.025	−0.013	0.495
$GDPG_{t-1}$	0.005	0.005	0.005	0.005	0.012	0.495
$LEAD_t$	−0.268	0.043	−0.277	0.042	0.147	0.442
$VIXMAX_t$	0.000	0.000	0.000	0.000	−0.215	0.415

Table A4. Comparison of pre-crisis (1) and crisis (3).

Variable	Model1_ Coefficient	SE	Model2_ Coefficient	SE	*t*-Statistic	*p*-Value
NPL_{it}	0.121	0.024	0.195	0.054	−1.253	0.106
$RWAC_{it}$	−0.001	0.001	−0.001	0.002	0.190	0.425
$WFUND_{it}$	0.001	0.001	0.007	0.003	−1.896	0.029 **
$RCAP_{it}$	−0.013	0.005	0.021	0.020	−1.680	0.047 **
$EBPT_{it}$	0.126	0.089	−0.067	0.082	1.591	0.056 *
$GDPG_{t-1}$	−0.005	0.002	−0.019	0.007	1.946	0.026 **
$LEAD_t$	0.002	0.013	0.172	0.086	−1.952	0.026 **
$VIXMAX_t$	0.000	0.000	0.000	0.000	−1.493	0.068 *

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table A5. Comparison of pre-crisis (1) and post-crisis (5).

Variable	Model1_ Coefficient	SE	Model2_ Coefficient	SE	*t*-Statistic	*p*-Value
NPL_{it}	0.121	0.024	0.085	0.018	1.192	0.117
*RWAC*it	−0.001	0.001	0.000	0.001	−0.246	0.403 *
*WFUND*it	0.001	0.001	0.001	0.003	−0.154	0.439 *
*RCAP*it	−0.013	0.005	−0.005	0.004	−1.320	0.094 *
$EBPT_{it}$	0.126	0.089	−0.020	0.037	1.523	0.064 *
$GDPG_{t-1}$	−0.005	0.002	0.005	0.005	−1.894	0.029 **
$LEAD_t$	0.002	0.013	−0.268	0.043	5.994	0.000 ***
$VIXMAX_t$	0.000	0.000	0.000	0.000	1.388	0.083 *

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.010$.

Table A6. Comparison of crisis (3) and post-crisis (5).

Variable	Model1_ Coefficient	SE	Model2_ Coefficient	SE	*t*-Statistic	*p*-Value
NPL_{it}	0.195	0.054	0.085	0.018	1.927	0.027 **
$RWAC_{it}$	−0.001	0.002	0.000	0.001	−0.363	0.358
$WFUND_{it}$	0.007	0.003	0.001	0.003	1.386	0.083 *
$RCAP_{it}$	0.021	0.020	−0.005	0.004	1.275	0.101
$EBPT_{it}$	−0.067	0.082	−0.020	0.037	−0.513	0.304
$GDPG_{t-1}$	−0.019	0.007	0.005	0.005	−2.870	0.002 ***
$LEAD_t$	0.172	0.086	−0.268	0.043	4.572	0.000 ***
$VIXMAX_t$	0.000	0.000	0.000	0.000	2.013	0.022 **

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.010$.

Table A7. Comparison of pre-crisis (adjusted) (2) and crisis (adjusted) (4).

Variable	Model1_ Coefficient	SE	Model2_ Coefficient	SE	*t*-Statistic	*p*-Value
NPL_{it}	0.127	0.018	0.152	0.065	−0.372	0.355
$RWAC_{it}$	−0.001	0.001	−0.003	0.003	0.661	0.254
$WFUND_{it}$	0.001	0.001	0.004	0.005	−0.684	0.247
$RCAP_{it}$	−0.012	0.006	0.050	0.025	−2.454	0.007 ***
$EBPT_{it}$	0.177	0.106	−0.115	0.062	2.384	0.009 ***
$GDPG_{t-1}$	−0.004	0.001	−0.010	0.013	0.445	0.328
$LEAD_{t}$	−0.012	0.011	0.140	0.094	−1.598	0.055 *
$VIXMAX_{t}$	0.000	0.000	0.000	0.000	−1.219	0.112

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.010$.

Table A8. Comparison of pre-crisis (adjusted) (2) and post-crisis (adjusted) (6).

Variable	Model1_ Coefficient	SE	Model2_ Coefficient	SE	*t*-Statistic	*p*-Value
NPL_{it}	0.127	0.018	0.079	0.016	2.001	0.023 **
*RWAC*it	−0.001	0.001	0.000	0.001	−0.224	0.411 *
*WFUND*it	0.001	0.001	0.001	0.003	−0.117	0.453 *
*RCAP*it	−0.012	0.006	−0.001	0.004	−1.472	0.071 *
$EBPT_{it}$	0.177	0.106	−0.020	0.025	1.810	0.035 **
$GDPG_{t-1}$	−0.004	0.001	0.005	0.005	−1.793	0.037 **
$LEAD_{t}$	−0.012	0.011	−0.277	0.042	6.144	0.000 ***
$VIXMAX_{t}$	0.000	0.000	0.000	0.000	0.706	0.240

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.010$.

Table A9. Comparison of crisis (adjusted) (4) and post-crisis (adjusted) (6).

Variable	Model1_ Coefficient	SE	Model2_ Coefficient	SE	*t*-Statistic	*p*-Value
NPL_{it}	0.152	0.065	0.079	0.016	1.083	0.140
$RWAC_{it}$	−0.003	0.003	0.000	0.001	−0.748	0.227
$WFUND_{it}$	0.004	0.005	0.001	0.003	0.565	0.286
$RCAP_{it}$	0.050	0.025	−0.001	0.004	2.066	0.020 **
$EBPT_{it}$	−0.115	0.062	−0.020	0.025	−1.424	0.078 *
$GDPG_{t-1}$	−0.010	0.013	0.005	0.000	−1.045	0.148
$LEAD_{t}$	0.140	0.094	−0.277	0.042	4.047	0.000 ***
$VIXMAX_{t}$	0.000	0.000	0.000	0.000	1.485	0.069 *

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.010$.

Appendix B. Testing Coefficient Differences from ALLL Regressions

Table A10. Comparison of pre-crisis (1) and pre-crisis (adjusted) (2).

Variable	Model1_ Coefficient	SE	Model2_ Coefficient	SE	*t*-Statistic	*p*-Value
NPL_{it}	0.477	0.107	0.636	0.091	−1.132	0.129
$RWAC_{it}$	0.008	0.004	0.007	0.004	0.058	0.477
$WFUND_{it}$	−0.003	0.002	−0.001	0.002	−0.694	0.244
$RCAP_{it}$	0.107	0.039	0.110	0.038	−0.050	0.480
$EBPT_{it}$	−0.130	0.140	−0.174	0.166	0.204	0.419
$GDPG_{t-1}$	0.008	0.015	0.007	0.011	0.046	0.482
$LEAD_{t}$	0.100	0.105	0.103	0.091	−0.026	0.490
$VIXMAX_{t}$	0.000	0.000	0.000	0.000	1.017	0.155

Table A11. Comparison of crisis (3) and crisis (adjusted) (4).

Variable	Model1_ Coefficient	SE	Model2_ Coefficient	SE	*t*-Statistic	*p*-Value
NPL_{it}	0.315	0.060	0.325	0.051	−0.138	0.445
$RWAC_{it}$	−0.003	0.002	−0.002	0.002	−0.023	0.491
$WFUND_{it}$	0.006	0.005	0.012	0.007	−0.696	0.244
$RCAP_{it}$	0.149	0.037	0.149	0.032	0.017	0.493
$EBPT_{it}$	0.050	0.053	0.024	0.061	0.319	0.375
$GDPG_{t-1}$	0.019	0.008	0.026	0.015	−0.459	0.324
$LEAD_t$	−0.063	0.054	−0.086	0.085	0.225	0.411
$VIXMAX_t$	0.000	0.000	0.000	0.000	0.328	0.372

Table A12. Comparison of post-crisis (5) and post-crisis (adjusted) (6).

Variable	Model1_ Coefficient	SE	Model2_ Coefficient	SE	*t*-Statistic	*p*-Value
NPL_{it}	0.377	0.039	0.390	0.035	−0.234	0.408
$RWAC_{it}$	0.004	0.004	0.001	0.004	0.488	0.313
$WFUND_{it}$	0.016	0.010	0.019	0.010	−0.266	0.395
$RCAP_{it}$	0.059	0.030	0.021	0.025	0.958	0.169
$EBPT_{it}$	−0.388	0.184	−0.258	0.152	−0.546	0.292
$GDPG_{t-1}$	0.008	0.005	0.008	0.005	0.047	0.481
$LEAD_t$	−0.191	0.072	−0.181	0.065	−0.100	0.460
$VIXMAX_t$	0.000	0.000	0.000	0.000	0.445	0.328

Table A13. Comparison of pre-crisis (1) and crisis (3).

Variable	Model1_ Coefficient	SE	Model2_ Coefficient	SE	*t*-Statistic	*p*-Value
NPL_{it}	0.477	0.107	0.315	0.060	1.329	0.092 *
$RWAC_{it}$	0.008	0.004	−0.003	0.002	2.499	0.006 ***
$WFUND_{it}$	−0.003	0.002	0.006	0.005	−1.579	0.058 *
$RCAP_{it}$	0.107	0.039	0.149	0.037	−0.776	0.219
$EBPT_{it}$	−0.130	0.140	0.050	0.053	−1.202	0.115
$GDPG_{t-1}$	0.008	0.015	0.019	0.008	−0.630	0.265
$LEAD_t$	0.100	0.105	−0.063	0.054	1.377	0.085 *
$VIXMAX_t$	0.000	0.000	0.000	0.000	3.326	0.000 ***

Note: * $p < 0.01$; ** $p < 0.05$; *** $p < 0.01$.

Table A14. Comparison of pre-crisis (1) and post-crisis (5).

Variable	Model1_ Coefficient	SE	Model2_ Coefficient	SE	*t*-Statistic	*p*-Value
NPL_{it}	0.477	0.107	0.377	0.039	0.879	0.190
$RWAC_{it}$	0.008	0.004	0.004	0.004	0.683	0.248
$WFUND_{it}$	−0.003	0.002	0.016	0.010	−1.817	0.035 **
$RCAP_{it}$	0.107	0.039	0.059	0.030	0.991	0.161
$EBPT_{it}$	−0.130	0.140	−0.388	0.184	1.118	0.132
$GDPG_{t-1}$	0.008	0.015	0.008	0.005	−0.027	0.489
$LEAD_t$	0.100	0.105	−0.191	0.072	2.278	0.011 **
$VIXMAX_t$	0.000	0.000	0.000	0.000	1.006	0.157

Note: * $p < 0.01$; ** $p < 0.05$; *** $p < 0.01$.

Table A15. Comparison of crisis (3) and post-crisis (5).

Variable	Model1_ Coefficient	SE	Model2_ Coefficient	SE	*t*-Statistic	*p*-Value
NPL_{it}	0.315	0.060	0.377	0.039	−0.881	0.189
$RWAC_{it}$	−0.003	0.002	0.004	0.004	−1.337	0.091 *
$WFUND_{it}$	0.006	0.005	0.016	0.010	−0.850	0.198
$RCAP_{it}$	0.149	0.037	0.059	0.030	1.906	0.029 **
$EBPT_{it}$	0.050	0.053	−0.388	0.184	2.292	0.011 **
$GDPG_{t-1}$	0.019	0.008	0.008	0.005	1.045	0.148
$LEAD_t$	−0.063	0.054	−0.191	0.072	1.425	0.077 *
$VIXMAX_t$	0.000	0.000	0.000	0.000	−3.574	0.000 ***

Note: * $p < 0.01$; ** $p < 0.05$; *** $p < 0.01$.

Table A16. Comparison of pre-crisis (adjusted) (2) and crisis (adjusted) (4).

Variable	Model1_ Coefficient	SE	Model2_ Coefficient	SE	*t*-Statistic	*p*-Value
NPL_{it}	0.636	0.091	0.325	0.051	2.975	0.002 ***
$RWAC_{it}$	0.007	0.004	−0.002	0.002	2.026	0.022 **
$WFUND_{it}$	−0.001	0.002	0.012	0.007	−1.793	0.037 **
$RCAP_{it}$	0.110	0.038	0.149	0.032	−0.777	0.219
$EBPT_{it}$	−0.174	0.166	0.024	0.061	−1.120	0.132
$GDPG_{t-1}$	0.007	0.011	0.026	0.015	−1.034	0.151
$LEAD_t$	0.103	0.091	−0.086	0.085	1.524	0.064 *
$VIXMAX_t$	0.000	0.000	0.000	0.000	3.029	0.001 ***

Note: * $p < 0.01$; ** $p < 0.05$; *** $p < 0.01$.

Table A17. Comparison of pre-crisis (adjusted) (2) and post-crisis (adjusted) (6).

Variable	Model1_ Coefficient	SE	Model2_ Coefficient	SE	*t*-Statistic	*p*-Value
*NPL*it	0.636	0.091	0.390	0.035	2.526	0.006 ***
*RWAC*it	0.007	0.004	0.001	0.004	1.139	0.128 **
*WFUND*it	−0.001	0.002	0.019	0.010	−2.057	0.020 **
$RCAP_{it}$	0.110	0.038	0.021	0.025	1.954	0.026 **
$EBPT_{it}$	−0.174	0.166	−0.258	0.152	0.369	0.356
$GDPG_{t-1}$	0.007	0.011	0.008	0.005	−0.077	0.469
$LEAD_t$	0.103	0.091	−0.181	0.065	2.545	0.006 ***
$VIXMAX_t$	0.000	0.000	0.000	0.000	0.229	0.410

Note: * $p < 0.01$; ** $p < 0.05$; *** $p < 0.01$.

Table A18. Comparison of crisis (adjusted) (4) and post-crisis (adjusted) (6).

Variable	Model1_ Coefficient	SE	Model2_ Coefficient	SE	*t*-Statistic	*p*-Value
NPL_{it}	0.325	0.051	0.390	0.035	−1.043	0.149
$RWAC_{it}$	−0.002	0.002	0.001	0.004	−0.805	0.211
$WFUND_{it}$	0.012	0.007	0.019	0.010	−0.594	0.276
$RCAP_{it}$	0.149	0.032	0.021	0.025	3.132	0.001 ***
$EBPT_{it}$	0.024	0.061	−0.258	0.152	1.715	0.043 **
$GDPG_{t-1}$	0.026	0.015	0.008	0.005	1.177	0.120
$LEAD_t$	−0.086	0.085	−0.181	0.065	0.894	0.186
$VIXMAX_t$	0.000	0.000	0.000	0.000	−3.412	0.000 ***

Note: * $p < 0.01$; ** $p < 0.05$; *** $p < 0.01$.

Notes

1 Our sample omits savings and loan holding companies and intermediate holding companies of foreign banking organizations. These institutions began filing FR Y-9C Call Reports during our sample period.

2 Throughout our sample period, there were regulatory and supervisory reforms that required new entities to file FR Y-9C reports (e.g., Goldman Sachs and Morgan Stanley started filing FR Y-9C in 2008 and Intermediate Holding Companies of Foreign Bank Holding Companies started filing FR Y-9C in 2014). We excluded these new filers from our sample.

3 These mappings are provided when we describe each variable used in our specification.

4 The largest such thrift acquisition during the financial crisis was Washington Mutual, which was acquired by JPMorgan in September 2008.

5 Provisions for loan and lease losses (BHCK4230) and total loans (BHCK2122) are from the Consolidated Financial Statements for Bank Holding Companies report (FR Y-9C). The corresponding items from the Office of Thrift Supervision (OTS) Thrift Financial Report (OTS-1313) are SO321 and the sum of SC26 and SC31.

6 For bank holding companies, the allowance for loan and lease losses was measured using item BHCK3123 from the FR Y-9C. For thrifts, this allowance was measured using item SC023 from the OTS-1313.

7 Nonperforming loans include total loans, leases, and other assets either 90 days past due or worse and still accruing or in nonaccrual, debt securities, and other assets either past due 90 days or more and still accruing or in nonaccrual (items BHCK1407, BHCK1403, BHC3506, and BHCK3507 from the FR y-9C). Analogously, thrift nonperforming loans were measured using the sum of PD20 and PD30 from OTS-1313.

8 Risk-weighted assets are measured by BHCAA223 and CCR78 from FR Y-9C and OTS-1313, respectively.

9 Data on real GDP are from the U.S. Bureau of Economic Analysis (Federal Reserve Economic Data 2020).

10 The Leading Index for the United States is available from the Federal Reserve Bank of Philadelphia (Federal Reserve Economic Data 2020).

11 Tier 1 capital is measured by item BHCA8274, $ALLL_{it}$ is measured by item BHCK3213, risk-weighted assets is measured by item BHCAA223 on the Y-9C. Thrift tier 1 capital is measured by item CCR20 and risk-weighted assets is measured by item CCR78 on the OTS-1313.

12 For bank holding companies the numerator of $EBPT_{it}$ is the sum of items BHCK4340, BHCK4230, and BHC4302; and the denominator is item BHCK3368 from the FR Y9-C. For thrifts, the numerator is the sum of items S091, SO321, and S071; and the denominator is item S1870 from the OTS-1313.

13 Wholesale funding includes securities sold under agreements to repurchase, commercial paper and other borrowed money with remaining maturity of one year or less (items BHCKB995, BHCK2309, and BHCK2332 from the Consolidated Financial Statements for Bank Holding Companies report).

14 The clustered standard errors are substantially larger than the errors for the same regressions with robust White-corrected standard errors. This result suggests that there are sufficient clusters in the bank dimension for the two-way clustering procedure to effectively correct the standard errors for heteroscedasticity.

15 Using a *t*-test, the statistical difference between pre-crisis and crisis periods (crisis and post-crisis periods) for this coefficient is statistically different at the five percent (10 percent) level.

16 The pre-crisis coefficient was statistically different from the crisis coefficient at the one percent level of confidence, the crisis coefficient was statistically different from the post-crisis coefficient at the five percent level, and the pre-crisis coefficient was statistically different from the post-crisis coefficient at the10 percent level.

17 The coefficients on lagged real GDP growth and the leading indicator during the crisis period are statistically larger than the corresponding coefficients during the pre-crisis period at the five percent confidence level when unadjusted bank holding company data are used.

18 Looking across the pre-crisis and crisis periods using forced merged (adjusted) data, the coefficients on the leading indicator are statistically different at the 5 percent confidence level.

19 Tables A5 and A8 in Appendix A show the provision behavior change statistically significant at the five percent confidence level or better during pre- and post-crisis periods.

20 Cummings and Durrani (2016) reported positive but insignificant coefficients on the measure of market uncertainty they included in their empirical model of provisioning.

21 Cross-period tests for coefficient differences across periods were significant at the 10 percent confidence level or better when unadjusted data are used, but such differences were only significant across the crisis and post-crisis periods—and only at the 10 percent confidence level—when merger-adjusted data are used.

22 Tables A4 and A7 in Appendix A show statistically insignificance of NPL coefficients estimates between pre-crisis and crisis periods.

23 Using a *t*-test, the coefficient for $RCAP_{it}$ is statistically higher in the pre-crisis period compared to the crisis period at a one (five) percent confidence level when unadjusted (adjusted) holding company are used. Comparing such coefficients across the

crisis and post-crisis periods, the coefficient is significantly higher during the crisis period only when unadjusted data and a 10 percent confidence level are used.

[24] The terminology of provisions used by Cummings and Durrani is equivalent to the loan loss allowances used in United States.

[25] The *t*-tests for differences in coefficients on lagged real GDP growth across periods indicate that there are no statistical differences at the 10 percent level or better, regardless of whether adjusted or unadjusted holding company data are considered.

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