The Effects of Bank Capital Requirements on Bank Lending:
What Can We Learn from the Post-crisis Regulatory Reforms*

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Abstract

We use events associated with the implementation of a number of U.S. post-crisis capital reforms to consider the impact of bank capital requirements on bank lending. We conduct our analysis separately for small bank holding companies (BHCs) – that is, BHCs with less than $50 billion but greater than $0.5 billion in total assets, for which Basel III represents the main post-crisis change in the capital regime – and for large BHCs – that is, BHCs with more than $50 billion in total assets that are subject to additional post-crisis reforms. In both cases we use the arrival of new information on capital requirements – which affected different BHCs by differential magnitudes – to estimate these impacts. The new information on capital requirements that we use varies between our small and large BHC analysis and our empirical strategies also differ. For small BHCs we rely on new information contained in the announcement of the U.S. banking agencies' proposed Basel III capital rules of June 2012 and final Basel III capital rules of July 2013 and, in particular, on changes in regulatory capital ratios implied by differences in how these rules set various assets' risk weights and define qualifying regulatory tier 1 capital. For small BHCs we conduct our analysis using BHC-level data for various categories of loans. For large BHCs we rely on the information contained in the first public release of the CCAR stress-test results in March 2012. We find negative but relatively small effects of increases in regulatory capital requirements on lending for small U.S. BHCs but larger effects for large BHCs for which, due to our use of a BHC-firm matched sample, we are able to control better for loan demand influences. For small banks we consider separately the impact of changes in regulatory capital requirement associated with both the announcement of Basel III proposed and final rules and find different sized effects, with the effects for the final rules being notably smaller.

JEL classification: G21, G28

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1. Introduction

The impact of capital regulation on bank intermediation activities remains a strongly debated issue among academics, regulators, and industry commentators alike. This debate, which began in the early 1990s with the introduction of capital regulations associated with Basel I, has reemerged in the last half-decade with the new wave of regulatory capital reforms developed both internationally and domestically in response to the 2007-2009 global financial crisis. In the United States, changes in bank capital requirements for all bank holding companies (BHCs) are related to the U.S. banking agencies' implementation of the internationally agreed Basel III capital standards. For large BHCs, changes in bank capital requirements are also related to the implementation of the capital component of the Dodd-Frank Act's (DFA's) enhanced prudential standards (EPS). While there seems to be a consensus that post-crisis capital reforms have increased the quantity and quality of bank capital, the risk coverage of bank capital, and, thereby, the resilience of the banking sector, whether these reforms induced banks to reduce their lending – with adverse implications for real economic activity – remains an open question.

This paper revisits the question of the effects of changes in bank capital requirements on bank lending by using events associated with the implementation of Basel III capital reforms and the capital reforms associated with the DFA's EPS.[1] We perform our analysis for both small BHCs – that is, BHCs with less than $50 billion but greater than $0.5 billion in total assets, for which Basel III represents the main post-crisis change in the capital regime – and for large BHCs – that is, BHCs with more than $50 billion in total assets that are subject to capital reforms stemming from both Basel III and the DFA's EPS.[2] Figure 1 shows the evolution of the common equity tier 1 (CET1) capital ratio introduced by the new regulatory framework for both small and large BHCs. Historically, small BHCs operated with larger regulatory capital ratios relative to the large BHCs. However, and most likely as a result of the post-crisis regulatory changes, the CET1 capital ratios of the large BHCs have increased substantially over the last 5 years and are currently at levels similar to that of smaller BHCs.

For both small and large BHCs our methodology relies the on arrival of new information on capital requirements that, importantly, affect different BHCs by differential amounts. The new information on capital requirements that we use for our small and large BHC analysis is, however, different due to more reforms than Basel III being relevant for large BHCs. Indeed, for large BHCs the capital reform that appears to be the most binding is part of the DFA EPS, rather than part of Basel III. In particular, the binding reform

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[1] The Basel III reforms also included liquidity reforms, which we do not consider in this paper. Henceforth where we refer to "Basel III reforms" we mean only the framework's capital reforms.

[2] BHCs that are smaller than $0.5 billion in total assets are not subject to Basel III but rather remain subject to the Federal Reserve Board's small BHC Policy Statement. Only BHCs with total assets greater than $50 billion are subject to the DFA's EPS, though the specific standards that they are subject to varies with BHC size.

for large BHCs appears to be the requirement that they undertake capital planning and hold capital to cover forward-looking risks; that is, they hold capital buffers that are sufficient to enable them to endure a prolonged period of severe stress and still be able to meet minimum capital requirements. We would note also that our empirical strategies also differ between small and large BHCs due to better data availability for large BHCs.

For our analysis related to the implementation of Basel III and the new information on BHC capital requirements associated with this reform, we rely on the fact that in the United States – as in most jurisdictions – internationally-agreed regulatory reforms like Basel III do not automatically get adopted in bank regulations. Rather, reforms get adopted into regulations following the administrative procedures that government agencies in that jurisdiction must follow, which, in some cases, can involve multiple steps. In the United States government agencies must first propose regulations and put them out for public comment and then only after reviewing and responding to public comments can regulations be finalized. As such, reforms do change and at different stages of the implementation process – that is, the internationally agreed reforms, the reforms implied by the proposed rule, and the reforms implied by the final rule – can be different. In the case of the implementation of the Basel III capital reforms in the U.S., this multi-stage process means that when a proposed rule or final rule is announced, BHCs receive new information on capital requirements. Indeed, our calculations indicate that Basel III reforms at different stages of the implementation process did imply quite notably different measured regulatory capital ratios. In particular, on average across BHCs, the BCBS-endorsed Basel III reforms reduced measured regulatory capital ratios (relative to Basel I), by 1.2 p.p., with a standard deviation of 1.7 p.p., while on average across BHCs, the proposed U.S. Basel III rules reduced measured regulatory capital ratios (relative to the BCBS-endorsed reforms) by 1.8 p.p., with a standard deviation of 1.2 p.p. Then, in the opposite direction, on average across BHCs, final U.S. Basel III rules increased measured regulatory capital ratios (relative to the proposed rules) by 1.2 p.p., with a standard deviation of 1.3 p.p. Notably, these changes in measured regulatory capital ratios, which are due wholly to changes in how asset risk weight or qualifying tier 1 capital are defined, are not small. For example, they are on the same order as the 2 p.p. magnitude of changes in minimum capital ratios implied by Basel III.

For our small BHC analysis we use BHC-level data for the 900 or so U.S. BHCs that are subject to Basel III and examine what changes in measured regulatory capital ratios imply for bank lending in the subsequent year. Our analysis based on BHC-level data follows in the tradition of work from the early 1990s – such as, Bernanke and Lown (1991) and Hancock and Wilcox (1993, 1994) – and revisited in the aftermath of the financial crisis by Berrospide and Edge (2010), Carlson, Shan, and Warusawitharana (2011), Aiyer, Calomiris, and Wieladek (2012), and Kupiec, Lee, and Rosenfeld (2015). What differs in our analysis from most of these papers, however, is our focus on – and ability to isolate – the effects of bank capital

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requirements on bank lending. With the exception of Aiyer *et al.* (2012), work by previous authors considered the effects of capital on bank lending, which is a broader concept encompassing both bank capital required by regulation as well as bank capital held voluntarily by banks. Like Aiyer *et al.* (2012), we focus on changes in regulatory capital requirements, however, whereas Aiyer *et al.* (2012) in their study for the U.K. examined the effects of a bank finding itself with a change in its capital requirement as a result of a time-varying (supervisor-imposed) bank-specific capital requirements (which is a requirement that regulators in the U.K. can deploy), we consider the effect of a bank finding itself with a change in its capital requirements as a result of changes made to the methodology for calculating regulatory capital ratios.

Our estimates indicate that a 1 p.p. increase in the equity capital ratio is associated with about a ¾ p.p. increase in annual growth rate of total loans which seems in the mid-range of previous estimates in the literature. The impact of the measured regulatory capital-ratio change is negative. That is, the fact that BHCs measured regulatory capital ratios declines when measured in a Basel III (proposed U.S. rule) basis relative to on a Basel I basis acts as a drag on loan growth. This effect is, however, only significant for real estate and consumer loans. This findings would be consistent with the fact that most of the changes in the Basel III regulatory reform were aimed at reducing mortgage lending exposures as discussed in section 2, although this explanation does not align with the fact that most of the impact of the measured regulatory capital-ratio change come though differences in the numerator of the regulatory capital ratios ($Reg.K.Rat.Chg.N$) consistent with stricter definitions on capital. Our estimates suggest that a 1 p.p. increase in the $Reg.K.Rat.Chg.N$, that is, an unexpected reduction in the numerator of the regulatory capital ratio of 1 pp. brought by stricter definitions of capital under Basel III leads to a 0.7 p.p. reduction in the growth rate of total loans. The reduction in C&I loan growth is even larger (about 1.4 p.p.).

Our analysis for large BHCs also relies on the arrival of new information on capital requirements but is complicated by the fact that a larger number of capital reforms have occurred for large BHCs. In particular, while capital reforms for large BHCs beyond Basel III are all part of DFA EPS, there are a few of elements to these reforms – specifically, annual capital plans and quantitative risk-based capital surcharges – and information about these reforms became known at different times. For large BHCs, however, the main piece of information about capital requirements in the post-crisis environment was the publication of the CCAR 2012 stress test results in March 2012. One of the new requirements for large BHCs in the post-crisis capital framework as that they hold capital to cover forward-looking risks; that is, they hold capital buffers sufficient to enable them to undergo a prolonged period of severe stress and still be able to meet minimum capital requirements. The results of the 2012 CCAR stress tests, by reporting the capital-ratio declines that BHCs experienced in the stress tests, specified the size of these buffers. As such, for our large BHC analysis we

examine what different capital-ratio declines under stressed conditions (albeit relative to other required buffers in the capital framework) imply for BHC lending in the subsequent year.

For our large BHC analysis we use matched data at the BHC-firm level for C&I lending. This data is provided in the FR Y-14 regulatory report, as part of the Federal Reserve's horizontal CCAR stress tests. This means that this data is only collected for the BHCs that participate in the stress tests and, in the case of C&I, have material C&I loan portfolios. *Currently*, 33 BHCs – specifically, those with assets greater than $50 billion – participate in the stress tests and of these 31 BHCs have material C&I loan portfolios. *Prior* to September 2012, however, which is a relevant time period for our analysis, only 18 BHCs – specifically, those with assets greater than $100 billion – participated in the stress tests and of these only 16 BHCs had material C&I loan portfolios. To be sure, the limited number of firms for which C&I loan-level data are collected reduces the number of independent observations in our analysis. Despite these limitations, however, these micro-level data are the closest data that we have for the U.S. to credit registry data that have been recently used in the literature to study the effects of capital requirements – see, for example, Jimenez, Ongena, Peydro, and Saurina (2013) for banks in Spain and Puri, Rocholl, and Steffan (2009) for German saving banks. For our large BHC analysis our use of C&I BHC-firm level data is quite novel.

Being able to use these data at the BHC-firm level allows us to overcome the typical identification concern associated with disentangling supply- from demand-driven changes in lending. In other words, using these data we are able to isolate the impact of capital reforms by controlling for loan demand at the firm-level. We do this following an approach similar to Khwaja and Mian (2008), which relies on firms that borrow from multiple BHC and given these multiple lending relationships within-firm loan-growth comparisons across BHCs. In particular, we examine, how loan growth for the same firm – over the course of the year following the release of the CCAR 2012 stress test results – differs between BHCs given differences in the sizes of these BHCs capital buffers (relative to other regulatory buffers) implied by the CCAR 2012 stress test results .

Our reduced-form models for both our cross-section regressions at the BHC level and our regressions at the BHC-firm level account for both the effect of the level of bank capital and for the change in capital requirements. To disentangle the effect of the change in capital requirements we measure the level of bank capital with the equity capital ratio rather than a measure of regulatory capital. In robustness analysis we go further and use a measure of capital surplus in place of the capital ratio. Consistent with previous results, we find that for small BHCs the effect of capital on lending is positive but relatively small. When we control for loan demand using a BHC-firm matched sample of the largest CCAR BHCs, the impact of capital seems much larger. Our estimates suggest that a 1 p.p. increase in equity capital increases 4-quarter C&I loan growth between 5 and 11 p.p. Considering an average C&I loan growth of about 13 percent for the CCAR BHCs between 2012 and 2013, this effect seems substantial.

We find a negative and significant effect of changes in capital regulatory requirements measured as declines in capital ratios as estimated in stress-tests on loan growth. The average effect for the sample of CCAR BHCs ranges between 3 and 8 p.p. The negative effects are much smaller as we augment the capital declines under stress with the capital conservation buffer and the GSIB surcharges calculated by the FSB based on the BCBS's methodology. These considerably large effects are consistent with previous studies on the effects of bank capital requirements on lending using BHC-firm-level data such as Jimenez, Ongena, Peydro, and Saurina (2013). One interpretation of our results being considerably larger for the largest BHCs, and consistent with the evolution of CET1 capital ratios in Figure 1, is that the news about higher capital requirements seemed to be almost non-binding for smaller BHCs, which were mostly well capitalized before the regulatory reforms and thus had insignificant effects on their lending decisions. Unlike small BHCs, large BHCs were operating with lower capital ratios and the news about higher capital requirements implied by the post-crisis capital reforms have led these institutions to raise considerably large amounts of capital to meet the stricter capital requirements, which as shown by our results, have had substantial effects on their lending decisions.

The paper is organized as follows. In section 2 we provide on background on U.S. post-crisis bank capital reforms for small and large BHCs. As part of this discussion we provide a more thorough review of the capital reforms that were contained in the BCBS's endorsed Basel III reforms, the proposed U.S. banking agencies' Basel III rules, and the final U.S. banking agencies' Basel III rules and highlight difference between these packages of reforms. The differences in reforms that we highlight here are a key variable in our cross-sectional analysis for small BHCs. We also provide a more thorough review of the capital reforms that apply to large BHCs and explain our emphasis on the results of the CCAR 2012 stress tests for our large BHC analysis. In section 3, we then explain the BHC-level and BHC-firm-level empirical strategies that we follow to examine the effects of capital regulatory requirements on bank lending and, in particular, how our small BHC empirical strategy makes use of differences between BCBS-endorsed and U.S. proposed and final Basel III reforms and our large BHC empirical strategy makes use of the CCAR 2012 stress-test results. Section 4 discusses the data used in our analysis with particular focus on the C&I loan-level data. In section 5, we present our results and discuss them relative to other findings in the literature on bank capital ratios and bank lending. Finally, in section 6, we conclude.

2. Background on U.S. post-crisis bank capital reforms for small and large BHCs

As noted earlier, for small BHCs – that is, BHCs with less than $50 billion but greater than $0.5 billion in total assets – Basel III represents the main post-crisis change in the capital regime. For large BHCs – that is, BHCs with more than $50 billion in total assets – reforms associated with the Dodd-Frank Act's (DFA's)

enhanced prudential standards (EPS) are also important. In the Federal Reserve Board's rules implementing EPS, the capital standards component has two parts: the requirement that large BHCs submit annual capital plans to the Federal Reserve Board (FRB) and the addition of a quantitative risk-based capital surcharge for large and interconnected BHCs. Because the timing of the implementation of all of these policies – and the new information that they implied about bank capital requirements – is central to our empirical strategy, in this section we summarize the key dates associated with the announcement reforms and what new information they implied. We start with a discussion Basel III, which applies to all BHCs in our analysis, before continuing to a discussion of the reforms that were part of the capital component of the DFA's EPS. Our discussion focuses primarily on when information on reforms became *known*, rather than on when on reforms became *effective*. In general, Basel III minima phased in over the period 2013 to 2015, while other elements – like the Basel III capital conservation buffer and surcharges for large and interconnected BHCs – phased in over 2016 to 2019. That said, there were many other phase-in schedules in Basel III that were specific to particular reforms and we do not detail all of these in this section.

Figure 2 shows the timeline of the U.S. post-crisis regulatory reforms. The key dates for the the Basel III capital reforms shown in the upper part of the figure were (i) the formal endorsement of the reforms by the governing body of the BCBS in September 2010, (ii) the U.S. banking agencies' proposal of the regulations for implementing the Basel III capital reform in June 2012, and (iii) the U.S. banking agencies' finalization of the regulations for Basel III in July 2013.[3] With regard to (i) we would note that in December 2009, prior to the formal endorsement of the Basel III capital reforms by the BCBS governing body, the BCBS issued a Consultative Document outlining the proposed reforms.[4]

In terms of the quantity of bank capital, the BCBS-endorsed Basel III capital reforms specified minima for common equity tier 1 (CET1) of 4.5 percent of risk-weighted assets (RWA), tier 1 capital of 6.0 percent of RWA, and total capital (tier 1 plus tier 2 capital) of 8.0 percent of RWA. In addition to the CET1 minimum, the reforms also specified a 2.5 percent capital conservation buffer that would always be in effect and an up to 2.5 percent countercyclical capital buffer that would be in effect (via an expansion of the

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[3] The key documents related to these reforms are (i) "Press release: Group of Governors and Heads of Supervision announces higher global minimum capital standards," BCBS, BIS, September 12, 2010, which announced the BCBS's endorsement of Basel III, and "Basel III: A global regulatory framework for more resilient banks and banking systems," BCBS, BIS, December 2010, for the contents of Basel III, (ii) "Regulatory Capital Rules: Regulatory Capital, Implementation of Basel III, Capital Adequacy, Transition Provisions, Prompt Corrective Action," 12 CFR Parts 208, 217, and 225, Regulations H, Q, and Y, Docket No. R 1442, Federal Reserve Board, June 2012, and (iii) "Regulatory Capital Rules: Regulatory Capital, Implementation of Basel III, Capital Adequacy, Transition Provisions, Prompt Corrective Action, Standardized Approach for Risk-weighted Assets, Market Discipline and Disclosure Requirements, Advanced Approaches Risk-Based Capital Rule, and Market Risk Capital Rule.," 12 CFR Parts 208, 217, and 225, Regulations H, Q, and Y, Docket No. R 1442, Federal Reserve Board, July 2013.
[4] See, "Consultative document: Strengthening the resilience of the banking sector," BCBS, BIS, December 2009.

capital conservation buffer) were policymakers to decide to activate it. The reforms also specified an initial calibration of a minimum tier 1 capital leverage ratio of 3 percent, expressed relative to a broad measure of *leverage exposure* that included more than just on-balance sheet total assets. The BCBS document outlining the Basel III capital reforms also noted that work was ongoing with the Financial Stability Board (FSB) to develop framework that would result in large and interconnected BHCs having greater loss absorbing capacity beyond minimum standards but beyond that provided no details.

Proposed and final U.S. Basel III regulations made all Basel III RWA-based capital ratios applicable to all BHCs with total consolidated assets greater than $0.5 billion. The Basel III 3 percent leverage ratio was, however, only applied to internationally active BHCs, although a 4 percent leverage ratio – expressed relative to total assets rather than leverage exposure – was included for all other BHCs with total consolidated assets greater than $0.5 billion. Proposed and final U.S. Basel III rules also indicated that the FRB intended to propose a quantitative risk-based capital surcharge for large and interconnected BHCs.

The BCBS-endorsed Basel III capital reforms introduced a regulatory minimum for a new capital ratio – specifically, CET1 – a subcomponent of tier 1 capital and eliminated a category of capital, so-called tier 3 capital. One important element of CET1 was its inclusion of accumulated other comprehensive income (AOCI) – that is, unrealized gains and losses in AFS securities – in addition to common shares, stock surplus, and retained earnings. The BCBS-endorsed Basel III capital reforms and the U.S. banking agencies' *proposed* Basel III rules excluded from tier 1 capital two elements of capital – specifically, "qualifying cumulative perpetual preferred stock" and "qualifying trust preferred securities" – that had under Basel I been considered tier 1 capital.[5] In the U.S. banking agencies' *final* Basel III rules – and in response to comments that highlighted the difficulties for community banks in raising other types of capital to replace these securities – existing securities that fell into these categories of capital were grandfathered-in as components of tier 1 capital.

The BCBS-endorsed Basel III capital reforms also introduced two measures to enhance the risk coverage of the capital framework. The first was to include the risks that banks face from counterparty credit exposures arising from derivatives, repo and securities financing activities in banks' determination of their capital requirements. The second was to mitigate banks' reliance on external ratings. Proposed and finalized U.S. Basel III regulations introduced corresponding formulas and methodologies to capture these risks in the capital framework. These Basel III reforms to enhance risk coverage expanded on similarly influenced reforms made to the Basel II framework – and agreed to by the BCBS in July 2009 – that raised capital

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[5] See, "Hybrid Capital Instruments and Small Institution Access to Capital," GAO, January 2012.

requirements for trading book and complex securitization exposures.[6] Proposed and finalized U.S. Basel III regulations also included formulas and methodologies to capture securitization exposures.

The *proposed* U.S rules implementing Basel III also included reforms that were not explicitly specified in the set of reforms included in the BCBS's September 2010 Basel III decision or in the July 2009 Basel II reform decision. These U.S. specific reforms included (i) higher risk weights for high volatility commercial real estate (HVCRE) loans; (ii) higher risk weights for past due loans; and, (iii) a modified system of risk weights for residential mortgages that differentiated the risks of these exposures (which under Basel I were generally assigned preferential risk weights).[7] With the exception of the latter reform relating to more differentiated residential mortgage risk-weights, all of these reforms were included in the final U.S. Basel III rules. Differentiated residential mortgage risk-weights were ultimately left out from the *final* rule due to concerns – highlighted in the comment process – that indicated that the operational burden and compliance costs of the proposed methodology for risk weighting residential mortgage exposures and the higher risk weights for certain types of mortgage products would increase costs to consumers and reduce their access to mortgage credit. Additionally, the U.S. Basel III final rules also permitted non-internationally active banking organizations to elect to opt-out from including AOCI in their CET1 calculations due to the possible volatility as a result of varying interest rates that this could lead to in their capital ratios.[8]

In summarizing our discussion of the changes in the bank capital regime implied by Basel III we would underscore that Basel III not only implied higher (or new) capital-ratio minimums – such as, a 2 p.p. increase in tier one minimum ratios from 4.0 percent in Basel I to 6.0 percent in Basel III – but additionally also implied changes in measured regulatory capital ratios that, moreover, were on the same order of magnitude as changes in minimum capital ratios. In addition, across BHCs, variation in measured regulatory capital ratio changes was notable. For example, according to our calculations and as shown in Figure 3, on average across BHCs, BCBS-endorsed Basel III capital reforms (relative to Basel I) reduced measured regulatory capital ratios by 1.2 p.p., with a standard deviation of 1.7 p.p. Likewise, on average across BHCs, U.S. proposed Basel III rules (relative to the BCBS-endorsed reforms) reduced measured regulatory capital ratios by a further 1.8 p.p., with a standard deviation of 1.2 p.p. Lastly, on average across BHCs, U.S. final Basel III rules (relative to the proposed rules) increased measured regulatory capital ratios by 1.2 p.p., with a standard deviation of 1.3 p.p. In our analysis for small BHCs we consider the effects of these changes in

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[6] See, "Enhancements to the Basel III framework," BCBS, BIS, July 2009.

[7] Higher risk weights for HVCRE loans were not discussed in the 2010 BCBS documents listed earlier. HVCRE loans were only mentioned as an asset for which higher risk weights could be considered "The Basel III capital framework: A decisive breakthrough," which was a speech given by Herve Hannoun (Deputy General Manager of the BIS) in November 2010. Even here, however, no mention of specific risk weights were given.

[8] For a discussion of this matter, see Gibson, M. (2012). "Testimony on Basel III" Before the Committee on Banking, Housing, and Urban Affairs, United States Senate, Washington, D.C. November 14, 2012.

measured regulatory capital ratios stemming from Basel III on small BHC lending. Finally note that Basel capital reforms that are agreed to apply only to internationally-active banking organizations. As such, the U.S. banking agencies' adopting most Basel III reforms for all BHCs with total assets greater than $0.5 billion was broader than what is required in the international Basel III agreement. Note that Basel I, when it was adopted in the United States, applied to BHCs with total assets greater than $0.5 billion, although Basel II when it was adopted applied only the internationally-active banking organizations.

For large BHCs – that is, BHCs with more than $50 billion in total assets – a larger number of reforms to the capital regime, beyond Basel III, have taken place. As shown in the lower part of Figure 2, reforms for large BHCs additionally include the Dodd Frank Act's (DFA's) enhanced prudential standards (EPS), which for bank capital involves the requirement that large BHCs submit annual capital plans to the FRB and the addition of a quantitative risk-based capital surcharge for large and interconnected BHCs. New information about the specifics for these reforms were announced in a number of different rules that were spread over the course of more than four years (June 2011 to August 2015). Many of these rules do not directly influence the empirical strategy that we use in our paper, nonetheless, we touch on them briefly. We would also note that for our analysis of large BHCs it is not just the issuance of rules that provided new information to BHCs. As we discuss below, the results of the stress tests – and, primarily, the first publically disclosed stress test results in March 2012 – also represent important information to BHCs.

The FRB issued proposed rules implementing enhanced prudential standards (EPS) for U.S. BHCs with more than $50 billion in total assets in December 2011 and then issued final rules in March 2014.[9] At the time that both the December 2011 proposed EPS rules and the March 2014 final EPS rules were issued, the Board had already issued its final Capital Plan rule. This rule, which laid out the specifics for large BHCs' annual submission of capital plans to the FRB, was finalized in November 2011.[10] The FRB's rule implementing a quantitative risk-based capital surcharge for large and interconnected BHCs was proposed in December 2014 and finalized in July 2015, which was after the FRB's EPS rules were proposed and finalized.[11] That said, the proposed and final EPS rules indicated that the FRB expected that its proposal for the surcharge would be based on the Basel Committee's GSIB surcharge approach, which at the time that the

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[9] See, "Enhanced Prudential Standards and Early Remediation Requirements for Covered Companies," 12 CFR Part 252, Regulation YY, Docket No. 1438, Federal Reserve Board, January 2012, and "Enhanced Prudential Standards for Bank Holding Companies and Foreign Banking Organizations," 12 CFR Part 252, Regulation YY, Docket No. R 1438, Federal Reserve Board, March 2014.

[10] See, "Capital Plans," 12 CFR Part 225, Regulation Y, Docket No. 1425, Federal Reserve Board, December 2011.

[11] See, "Risk-Based Capital Guidelines: Implementation of Capital Requirements for Global Systemically Important Bank Holding Companies," 12 CFR Part 217, Regulation Q, Docket No. R 1505, Federal Reserve Board, December 2014, and "Risk-Based Capital Guidelines: Implementation of Capital Requirements for Global Systemically Important Bank Holding Companies," 12 CFR Parts 208 and 217, Regulations H and Q, Docket No. R 1505, Federal Reserve Board, August 2015.

proposed EPS rules were issued had recently been endorsed by the governing body of the BCBS – in November 2011 – following the earlier issuance of the BCBS's Consultative Document on the approach – in July 2011. The proposed and final EPS rules also indicated that surcharge would act as an expansion to the Basel III capital conservation buffer, which is also how the July 2011 and November 2011 BCBS GSIB documents recommended to incorporate the surcharge in the capital regime.

At the same time that the BCBS announced the endorsement the BCBS GSIB methodology, the Financial Stability Board (FSB) published a list of BHCs that would face the surcharge. This document, which included eight large and interconnected U.S. BHCs, did not specify the size of the surcharge that any BHC would face, although, given the methodology, these eight BHCs knew that their surcharge would be between 1 p.p. and 2.5 p.p. In November 2012 and in November in all years since, the FSB has published what BHCs' surcharges would be given the BCBS's endorsed methodology. Note, however, that since the FRB's proposed and final rules for the GSIB surcharge specified two methodologies for calculating the GSIB surcharge – the higher of which would be binding – from November 2014 onwards the FSB's annual published list of GSIB surcharges was not really informative for U.S. BHCs.[12]

The FRB's November 2011 Capital Plans rule set the requirement that large BHCs submit an annual capital plan to the FRB that demonstrate the BHC's ability to maintain capital above minimum capital ratios under both expected and stressed conditions over a nine-quarter, forward-looking planning horizon and obtain approval from the FRB under certain circumstances before making a capital distribution. This rule introduced a forward-looking perspective to the risk coverage of BHC capital and to bank supervisors' assessment of bank capital adequacy.

An important element of the Capital Plan rule is the FRB's use of its own *pro forma* estimates of BHC losses, income, and capital ratios under expected and stressed conditions in reviewing large BHCs' capital plans and in evaluating whether BHCs can maintain capital ratios above regulatory minimums even after experiencing these conditions. These calculations of *pro forma* estimates of BHC capital ratios are known as the Comprehensive Capital Analysis and Review (CCAR) stress tests. The capital-ratio declines that are calculated for large BHCs under stressed conditions (which, in practice, are the binding constraint) represent capital-ratio buffers that BHCs must hold in order to continue to meet regulatory minimums even after enduring prolonged periods of severe stress.

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[12] The two methodologies specified were the U.S. GSIB surcharge were (i) the BCBS's methodology and (ii) a modified methodology that replaced one of the BCBS's criteria for determining the surcharge, specifically, the BHC's substitutability, with the BHC's use of short-term wholesale funding.

The CCAR stress tests that the FRB undertook over the winter of 2011 and 2012 – known as CCAR 2012 – resulted in the publication, in March 2012, of supervisory estimates of BHCs' *pro forma* losses and income and BHCs' *pro forma* capital-ratio declines under stressed conditions. Although the CCAR 2012 stress tests were not the first CCAR stress tests, they were the first tests (since the original 2009 SCAP stress tests) for which results were published – a practice that has continued in all subsequent CCAR stress tests. In CCAR 2011, however, which was the very first CCAR stress test, there was no disclosure of results to either to the public or to the BHCs, although the latter group were told whether their capital plans had been approved of not (see Edge and Lehnert, 2016).

The publication in March 2012 of the CCAR 2012 stress test results represented new information for large BHCs since the capital-ratio declines under stressed conditions clarified the size of the capital buffers that BHCs needed to hold in order to withstand a prolonged period of severe stress and be able to satisfy minimum capital requirements. On average across large BHCs, *pro forma* capital ratios declined 3.2 p.p. in CCAR 2012, with a standard deviation of 2.1 p.p. Because the capital buffers implied by the CCAR 2012 stress tests were generally larger than the Basel III capital conservation buffer and – depending on the BHC – the conservation buffer expanded by the GSIB surcharge, CCAR is generally the binding capital requirement. In our analysis for large BHCs we, therefore, consider the effects of large BHCs *pro forma* capital-ratio declines on large BHC lending.

For a few BHCs, however, the stress-test capital-ratio declines are not the binding buffer; rather the binding buffer is either the capital conservation buffer or the conservation buffer expanded by the GSIB surcharge. In performing our analysis, therefore, we also adjust the stress test's *pro forma* capital ratios declines relative to other buffers or surcharges. Note that information on these other buffers and surcharges were available at the time of the publication of the March 2012 results, although the information was what had been described in BCBS in their documents rather than in U.S. regulations.

3. Empirical strategy

As noted, we follow two approaches in considering the effects of bank capital reforms on bank lending. The first approach uses BHC-level data for all of the 900 BHCs subject to Basel III in the United States and considers the effects of changes in measured regulatory capital ratios on small BHC lending growth. The second approach uses BHC C&I bank-firm-level data, which is constructed from loan-level data collected for the very large BHCs that participate in the stress tests (CCAR BHCs) and, in the case of C&I, have material C&I loan portfolios. This bank-firm level data allows us in our analysis to better control for loan demand using a within firm estimation method. For this analysis we consider what different capital-ratio declines under stressed conditions – as reported in the March 2012 stress tests – imply for BHC lending. Our rationale

for focusing on capital-ratio declines under stressed conditions stems from the requirement in the post-crisis capital framework for large BHCs to hold capital buffers sufficient to enable them to endure a prolonged period of severe stress and still be able to meet minimum capital requirements. The capital-ratio declines that a BHC experiences in the stress tests indicates the size of the buffer that the BHC must hold.

3.1. BHC-level analysis

In our BHC-level analysis we examine the impact of Basel III capital reforms on bank lending using equations that link BHC loan-growth to BHC capital ratios and the unanticipated change in measured regulatory capital ratios, which we refer to as the "regulatory capital change." We do this both for the announcement of the proposed rule in 2012:Q2 as well as the announcement of the final rule in 2013:Q2. In particular, we use the following cross-section regression specification:

$$Loan\ Growth_i = \alpha_0 + \alpha_1 \cdot K\ Ratio_i + \alpha_2 \cdot Reg.\ K\ Ratio\ Chg._i + \alpha_3 \cdot X_i + \varepsilon_i, \tag{1}$$

where $Loan\ Growth$, our dependent variable, is the one-year growth rate in total loans (and later different loan growth categories, like C&I, consumer credit, and mortgages), $K\ Ratio$, our first main variables of interest, is the BHC's equity capital ratio, and $Reg.\ K\ Ratio\ Chg.$, our second main variable of interest is the unanticipated change in measured regulatory capital ratios. This later variable varies somewhat with the context. In particular, we define it so that it is always positive. This means that for considering new information contained in the proposed U.S. Basel III rules, $Reg.\ K\ Ratio\ Chg.$ is defined as:

$$Reg.\ K\ Ratio\ Chg._i\ (Proposed) = Basel\ I\ Tier\ 1\ K\ Ratio_i - Basel\ III\ Tier\ 1\ K\ Ratio_i\ (Proposed)$$

However, when we estimate equation (1) and consider new information contained in the U.S. banking agencies' final Basel III rule, we also define the variable $Reg.\ K\ Ratio\ Chg.$ so that it will be positive; that is,

$$Reg.\ K\ Ratio\ Chg._i\ (Final) = Basel\ III\ Tier\ 1\ K\ Ratio_i(Proposed) - Basel\ III\ Tier\ 1\ K\ Ratio_i(Final)$$

The variable X in equation (1) denotes BHC controls, which include size (measured as the log of total assets), return on equity (ROE), the net charge-off rate (net charge-offs over total assets), proxies for liquidity and funding such as the ratios of liquid assets and deposits to total assets respectively, and a loan demand indicator constructed for each BHC.

Calculating the variable, $Reg.\ K\ Ratio\ Chg.$, to be used in estimating equation (1) in the context of considering new information contained in the U.S. banking agencies' proposed Basel III rule requires an assumption of whether small U.S. BHCs expected that BCBS-endorsed Basel III capital reforms would ultimately be applied to them when the BCBS endorsed its reforms in December 2010 or realized this only when the U.S. banking agencies proposed to adopt Basel III for all BHCs with assets greater than $0.5 billion

in July 2012. We allow for this possibility in estimating equation (1). In the former case, the variable $Reg. K\ Ratio\ Chg.$ for each BHC in 2012:Q2 is equal to the difference between the BHC's measured capital ratio calculated according to the BCBS-endorsed reforms and the its measured capital ratio calculated according to the U.S. banking agencies' proposed Basel III rule. Both of these components of $Reg. K\ Ratio\ Chg.$ can be calculated following supplementary documentation accompanying FRB congressional testimony on Basel III given in November 2012.[13] This documentation explains how BHCs' measured capital ratios can be estimated under the U.S. Basel III proposed rules. Because the way that the U.S. Basel III proposed rules for small BHCs differ from the BCBS endorsed reforms is that they include (i) higher risk weights for high volatility commercial real estate loans; (ii) higher risk weights for past due loans; and (iii) a modified system of risk weights for residential mortgages that differentiated the risks of these exposures, removing these elements from the calculation of capital ratios provides estimates of BHCs' measured capital ratios under the BCBS-endorsed Basel III proposal.

In the latter case that small U.S. BHCs only expected Basel III to apply to them the U.S. banking agencies proposed to adopt Basel III for all BHCs with assets greater than $0.5 billion in July 2012, the variable $Reg. K\ Ratio\ Chg.$ for each BHC in 2012:Q2 is equal to the difference between the BHC's measured capital ratio calculated according to Basel I rules and the its measured capital ratio calculated according to the U.S. banking agencies' proposed Basel III rule. The above-mentioned document that explains how BHCs' measured capital ratios can be estimated under the U.S. Basel III proposed rules also explains how such ratios can be estimated under U.S. Basel I rule, so providing the inputs for the variable $Reg. K\ Ratio\ Chg.$

When we estimate equation (1) in the context of considering new information contained in the U.S. banking agencies' final Basel III rule, we calculate the variable, $Reg. K\ Ratio\ Chg.$ for any BHC as the difference between the BHC's measured capital ratio calculated according to the U.S. banking agencies' final Basel III rule and the BHC's measured capital ratios calculated according to the proposed rule. The calculation of the later variable is as discussed in the preceding two paragraphs. Because the way that the U.S. Basel III final rules differ from the proposed rules is that they (i) exclude the proposed rule's modified system of risk weights for residential mortgages and (ii) grandfather-in of existing "qualifying cumulative perpetual preferred stock" and "qualifying trust preferred securities" as components of tier 1 capital that were excluded from tier 1 capital in the U.S. banking agencies' proposed rule removing these two elements from the calculation of capital ratios provides estimates of BHCs' measured capital ratios under the U.S. banking agencies final Basel III rules.

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[13] See again, Gibson, M. (2012).

When we estimate equation (1) in the context of considering new information contained in the U.S. banking agencies' final Basel III rule, $Loan\ Growth$, our dependent variable, is measured over the period between June 2013 and June 2014 and $K\ Ratio$ is the BHC's equity capital ratio in June 2013. In addition, all control variables, X, in equation (1) are measured as of June 2013.

Our expectations in equation (1) are for a positive sign of the coefficient on the variable $K\ Ratio$ – that is, $\alpha_1 > 0$ –, and a negative sign for the coefficient on the variable $Reg.\ K\ Ratio\ Chg.$ under the proposed and the final rules – that is, $\alpha_2 < 0$. Our expectation for $\alpha_1 > 0$ reflects the general assessment that banks with higher levels of capital, because they are further above their capital requirements, should be less constrained in their lending activities and, all else equation, in a better position to expand their lending. This relationship has been found in many previous analyses of bank lending dating back to Bernanke and Lown (1991), who considered both cross-sectional U.S. state-level equations and cross-sectional bank-level equations for banks in New Jersey linking bank loan growth to bank capital-to-assets ratios and employment. Later, Berrospide and Edge (2010) also considered this relationship – in their case for a panel consisting of the 165 largest U.S. bank holding companies over the period 1992 to 2009 – as too did Carlson *et al.* (2011) – in their case using both panel and cross-section regressions for a sample of U.S. banks over the period 2001 to 2009 that raised 80 percent or more of their deposits within a given radius of their headquarters and could be matched with a similar virtual twin-type bank.

More recently, Kupiec, Lee, and Rosenfeld (2015) also included bank capital in their models that study the impact of poor bank examination ratings on loan growth. Although these papers all find positive relationships for the effect of bank capital ratios on bank lending, they find quite a range of magnitudes. For example, while a 1 p.p. higher equity to assets ratio implies a 2 p.p.to 2½ p.p. higher growth rate of loans in Bernanke and Lown, it implies only a ¾ p.p. to 1¼ p.p. higher growth rate of loans in Berrospide and Edge, a 0.05 p.p. to ¼ p.p. higher growth rate of loans in Carlson *et al.* and 0.05 p.p. to 0.1 p.p. higher growth rates of loans in Kupiec *et al.* Additionally, when Carlson *et al.* performed their sequence of cross-section regressions between 2001 and 2009, they found no significant relationship for most years but significant effects on the order of ¼ p.p. to ½ p.p. in 2007, 2008, and 2009; that is, crisis years.

Our expectation for $\alpha_2 < 0$ reflects the general assessment that, all else equal, a bank that unexpectedly finds itself with a lower measured capital ratio relative to its required ratio will expand its lending more slowly. This reflects the fact that a bank with an unexpectedly lower measured capital ratio will likely want to restore, at least to some extent, its capital ratio back to where it was relative to its required ratio and reducing its loans is one way to do this. A number of papers have taken this approach to gauging the effects of bank capital ratios on lending, with some papers focusing on a bank unexpectedly finding itself with a higher or lower capital ratio relative to its regulatory requirement as a result of an exogenous (non-demand

related) change in its capital ratio and other papers focusing on a bank facing an unexpectedly higher or lower capital requirement. Our consideration of the $Reg. K \ Ratio \ Chg.$ variable lies in between these two ways through which a bank can find itself with a lower actual capital ratio relative to its required ratio. In our case a bank finds itself with a higher or lower regulatory capital ratios due to regulatory changes that it could not anticipate that changed the definition of capital and the definition of risk weighted assets.

Rice and Rose (2012) and Puri, Rocholl, and Steffan (2011) represent two papers that estimate the effects of bank capital ratios on lending by considering banks unexpectedly finding themselves with higher or lower actual capital ratios for exogenous reasons. Rice and Rose – for U.S. banks with assets under $10 billion – examine at the effects on bank lending of declines in bank capital ratios that resulted from GSE equity prices falling to essentially zero during the crisis. Similarly, Puri *et al.* – for German savings banks – investigate the effect on bank loan approvals of drops in bank capital ratios from these 34 banks' ownership of one of the country's 11 Landesbanks, three of which were affected by losses from the U.S. subprime crisis and eight of which were not. Aiyer, Calomiris, and Wieladek (2012) and Jimenez, Ongena, Peydro, and Saurina (2013) are two papers that estimate the effects of bank capital ratios on lending by considering banks unexpectedly finding themselves with higher or lower capital requirements. Aiyer *et al.* – who focus on U.K. banks – look at the effect on a bank's lending if it finding itself with different capital requirement as a result of time-varying (supervisory) bank-specific Basel Pillar II capital requirements. Jimenez *et al.* – for Spanish banks – examine the effects on bank lending of banks finding themselves with higher or lower tier 2 capital requirements (which equal accumulated loan and lease loss requirements) as a result of both tightenings and loosenings in Spain's dynamic provisioning policy on bank lending.

The findings from these papers are somewhat more difficult to compare since in some cases – *e.g.*, Rice and Rose – the relevant explanatory variable is whether the bank experienced a large drop in capital and not the size of the drop in capital, while in other cases – e.g., Puri *et al.* – the dependent variable is loan approvals rather than loan volumes. Aiyer *et al.* and Jimenez *et al.*, however, both consider the effects of bank capital requirement changes on bank lending and both find considerably larger effects than any of the studies that look at ratios alone. Aiyer *et al.*, for example, find that a 1 p.p. increase in supervisory capital ratios implies a 6 to 9 p.p. reduction in loan growth (depending on the approach they take to control for the effect of demand on loan growth), while Jimenez *et al.* find even larger effects.

When we estimate equation (1) in the context of considering new information contained in the U.S. banking agencies' proposed Basel III rule, the variable $Reg. K \ Ratio \ Chg.$ will in general be positive because – given the more narrow definition of capital and the higher risk weights contemplated under the Basel III regime – Basel III capital ratios will, in general, be smaller than either BCBS-endorsed Basel III ratios or Basel I ratios. Note that the variable $Reg. K \ Ratio \ Chg.$ calculated under the final Basel III rules will in

general be negative because Basel III capital ratios under the final rules are larger than under the proposed rules. Thus, we also expect $\alpha_2 < 0$ consistent with a positive impact on lending resulting from the boost in capital brought by the final rules relative to the proposed rules.

Note also that our $Reg. K\ Ratio\ Chg.$ variable can be decomposed into the part of the change that was due to narrower capital definitions and the part that is due to higher risk-weight assumptions. Equation (2), below, shows this decomposition, in the context of the difference between measured capitals under the U.S. banking agencies' proposed Basel III rule and under Basel I.

$$
\begin{aligned}
Reg. &K\ Ratio\ Chg._i\ (Proposed) \\
&= Basel\ I\ Tier\ 1\ K\ Ratio_i - Basel\ III\ Tier\ 1\ K\ Ratio_i \\
&= \frac{Basel\ I\ Tier\ 1\ K_i}{Basel\ I\ Risk\ Weighted\ Assets\ (RWA)_i} - \frac{Basel\ III\ Tier\ 1\ K_i}{Basel\ III\ Risk\ Weighted\ Assets\ (RWA)_i} \\
&= \underbrace{\frac{Basel\ I\ Tier\ 1\ K_i - Basel\ III\ Tier\ 1\ K_i}{Basel\ I\ RWA_i}}_{Reg.K.Rat.Chg.N_i\ :\ Due\ to\ Narrower\ K\ Definitions} + \underbrace{\frac{Basel\ III\ Tier\ 1\ K_i}{Basel\ III\ RWA_i} \cdot \frac{Basel\ III\ RWA_i - Basel\ I\ RWA_i}{Basel\ I\ RWA_i}}_{Reg.K.Rat.Chg.D_i\ :\ Due\ to\ Higher\ RW\ Definitions}
\end{aligned}
$$

$$(2)$$

In specifications of equation (1) where we replace the variable $Reg. K\ Ratio\ Chg.$ with its two components – that is, $Reg. K\ Ratio\ Chg.N$ and $Reg. K\ Ratio\ Chg.D$ – we would expect negative values for their coefficients; that is, $\alpha_{2,N} < 0$ r and $\alpha_{2,D} < 0$.

3.2. C&I BHC-firm level analysis

We follow two approaches to consider the impact on the lending of large BHCs of differential *pro forma* capital-ratio declines that in turn imply different-sized capital buffers that the BHC is required to hold. Both of these approaches are based on Khwaja and Mian's (2008) study of the effects of bank liquidity shocks in Pakistan on bank lending. The first approach that we use relies on firms borrowing from multiple banks and these multiple banks being differentially impacted by the new regulatory information in question, where in our case the information concerns the size of the capital buffer that large BHCs are required to hold so as to withstand a period of prolonged severe stress, which is different across BHCs. The second approach that we use examines how a BHC's volume of loans to a particular firm is influenced by bank characteristics – including the size of the capital buffer, as implied by the stress tests, that BHCs need to hold – while controlling for firm-specific characteristics.

The first approach is our preferred approach for examining the effects of regulatory capital changes on bank lending. Its only drawback is that – because it only uses loans that are extended to firms that also

have another loan with a different bank in our dataset – it ends up using only a fraction of the total number of loans in our dataset. Our second approach makes use of a far greater fraction of the loans in our dataset, although it does not isolate the effects of a change in bank capital ratios as cleanly. We would note that other studies – such as, Jimenez, Ongena, Peydro, and Saurina (2013) – have also used BHC-firm-level data in this way to examine the effects of bank capital or liquidity, in their case on bank lending.

Our first approach compares how – after new regulatory information becomes available – the same firm's loan growth from one BHC changes relative to another BHC that is less affected by the new information (*e.g.*, a smaller forward-looking capital buffer). We start by implementing this methodology using a firm fixed-effect regression on a sample of firms with multiple banking relationships. To study the impact of equity capital ratios and the change in regulatory capital ratios, we split our sample into two types of BHCs, those BHCs that are *more sizably impacted* by the new regulatory information and those that are *less sizably impacted* by the new information. We examine firms that borrow from multiple BHCs and where these BHCs include at least one of each type of BHCs; that is, more sizably impacted and less sizably impacted. There are 17 BHCs lending to about 4000 firms with multiple banking relationships as of March 2012 (at the time when new information because available), and thus a total of 9214 BHC-firm observations.[14] We consider the impact of new regulatory information on loan growth of bank i to firm j using the following cross-section regression:

$$Loan\ Growth_{ij} = \alpha_0 + \alpha_1 \cdot K\ Ratio_i + \alpha_2 \cdot Reg.\ K\ Ratio\ Chg._i + \alpha_3 X_i + f_j + \varepsilon_{ij} \qquad (3)$$

In this specification we include firm fixed effects, f, and use only multi-bank-type firms; that is, firms borrowing from at least one more sizably impacted BHC and at least one less sizably impacted BHC.

For our second approach we add firms that borrow from only a single bank in the data sample and firms that borrow from two or more BHCs but these BHCs are all only one type of BHC; that is either more sizably impacted BHCs or less sizably impacted BHCs. In this case, we employ OLS regressions including both bank and firm controls, firm industry dummies. In these regressions we cluster the standard errors at the firm level. There are 34,072 firms borrowing from a single BHC or from two or more BHC that are the same type of BHC. Thus, our full sample of firms has 43,286 BHC-firm observations. We augment our specification regression when we use all firms:

$$Loan\ growth_{ij} = \alpha_0 + \alpha_1 \cdot K\ Ratio_i + \alpha_2 \cdot Reg.\ K\ Ratio\ Chg._i + \alpha_3 X_i^b + \alpha_4 X_j^f + \varepsilon_{ij} \qquad (4)$$

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[14] We exclude from this analysis one BHC specialized in credit-card loans as it has no corporate loans of at least $1 million.

The variable X_i^b is a vector of BHC controls as before and X_j^f is a vector of firm controls which include: size (log of total assets), the cash/assets ratio, EBITDA/assets, the ratio of total debt to assets (leverage ratio), and the firm sales/assets ratio. We also include industry dummies using the 2-digit NAICS codes. As was the case with our BHC-level analysis we also consider components of the variable $Reg. K\ Ratio\ Chg.$

Our expectations for the signs of α_1 and α_2 in equations (3) and (4) are the same as those described above for when we use BHC-level data (that is, $\alpha_1 > 0$ and $\alpha_2 < 0$).

We work with a few different definitions of the variable $Reg. K\ Ratio\ Chg.$ for our analysis of the larger firms. First, in line with the analysis for smaller (non-CCAR) BHCs we also use a definition of $Reg. K\ Ratio\ Chg.$ based on information about Basel III; that is,

$$Reg. K\ Ratio\ Chg._i\ (Proposed) = Basel\ I\ Tier\ 1\ K\ Ratio_i - Basel\ III\ Tier\ 1\ K\ Ratio_i\ (Proposed)$$

where, as before this is also calculated for 2012:Q2 and under in a regression that studies 2012:Q2 to 2013:Q2 loans growth. We do not, however, use the final rule counterpart to the variable $Reg. K\ Ratio\ Chg.$ variable for 2013:Q2 to 2014:Q2 loan growth regressions because there is essentially no variability across BHCs for this variable.

One reason not to use the variable $Reg. K\ Ratio\ Chg.$ for large CCAR BHCs is, as discussed in section 2, that it is likely not the case that Basel III was the binding regulatory capital requirement on BHCs. Rather the stress tests were more likely the binding requirement. Indeed, the capital-ratio declines that are calculated for large BHCs under stressed conditions represent capital-ratio buffers that BHCs must hold in order to continue to meet regulatory minimums even after enduring prolonged periods of severe stress. The blue bars in Figure 4 reports the decline in capital that each BHC that was part of CCAR 2012 experienced in those stress tests. As discussed, the CCAR analysis was completed and results reported in March 2012, which was the first time results were published. Note, however, that as part of Basel III BHCs would also have to hold a capital conservation buffer (CCB) and, although at the time the CCB was not phased in, this alternative buffer would have been well known by CCAR BHCs. As such, in March it would only be the decline in capital that banks experienced in CCAR in excess of the CCB that would have been the new information to the BHC about the capital buffers that they needed to hold.

Note also that the CCBs applicable to each BHC would not have been the same since the GSIB surcharge acts as an expansion to the CCB. Indeed, it is for this reason that the black dotted CCB line in Figure 4 has been increased for BHCs subject to the GSIB surcharge. As such, it would be the decline in capital that banks experienced in CCAR in excess of the CCB that would have been the new information to the BHC about the capital buffers that they needed to hold. We show two alternatives for the CCB plus GSIB

lines for the reason that in March 2012 BHCs subject to the GSIB surcharge knew that they were subject to the surcharge (since the FSB had published the list of BHCs in November 2011) but, despite a methodology paper having been published by the BCBS (also in November 2011), really only knew that their surcharge would be between 1 p.p. and 2.5 p.p. The green line in Figure 4 therefore assumes that each BHC to which the GSIB surcharge applied assumer their surcharge to be at the mid-point of the 1 p.p. to 2.5 p.p. range. In November 2012 the FSB published the list of GSIB BHCs and their surcharges, so the purple line in Figure 4 assume that BHCs perfectly guessed these in March 2012. Ultimately, what we assume about what BHCs expected regarding the size of their GSIB surcharges does not alter results.

4. Data

We use two main sources of data in our empirical analysis. For our BHC-level analysis, we use consolidated bank balance sheet data at the BHC level from regulatory filings (FR-Y9C) for all BHCs subject to Basel III; that is, companies with total consolidated assets of at least $500 million. We combine this information with data from the FDIC's Summary of Deposits data in order to construct BHC-specific measures that control for loan demand. Specifically, we weigh aggregate economic measures such as personal income, home prices, and unemployment rates at the state level with BHC deposit shares in each of the 50 states in which the company operates.

For our loan level analysis, we also use regulatory filings that provide detailed information of BHC's commercial and industrial (C&I) loan portfolios (Corporate Schedule of FR-Y14) available for about 30 BHCs subject to the Federal Reserve's Comprehensive Capital Assessment Review (CCAR). These data include loan information at the credit facility level for both committed and utilized balances greater than or equal to $1 million in loan. In terms of the CCAR FR-Y14 Corporate Schedule these loans would be "Category 4 and 5" C&I loans.[15] To minimize the possible impact of outliers, we winsorize our BHC and firm-level data at 1 the percent level.

In our small BHC analysis we estimate equation (1) for the 900 BHCs subject to Basel III to consider the effects of changes in measured regulatory capital ratios as a result of Basel III implementation on small BHC lending. When we estimate equation (1) in the context of considering new information contained in the U.S. banking agencies' proposed Basel III rule, $Loan\ Growth$, our dependent variable, is measured over the period between June 2012 and June 2013, $K\ Ratio$ is the BHC's equity capital ratio in June 2012, $Reg.K\ Ratio\ Chg.$ is calculated for as for June 2012, and all control variables, X, in equation (1) are

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[15] Our focus on so-called "Category 4 and 5" loans in the Corporate Loan schedule means that we are excluding C&I loans to U.S. and foreign banks, other depository financial institutions, and non-depository financial institutions, and loans to financial agricultural production and other loans to farmers,

measured as of June 2012. When we estimate equation (1) in the context of considering new information contained in the U.S. banking agencies' final Basel III rule, $Loan\ Growth$, our dependent variable, is measured over the period between June 2013 and June 2014 while $K\ Ratio$, $Reg.K\ Ratio\ Chg.$, and all control variables, X, are measured as of June 2013.

In our large BHC analysis we estimate equations (3) and (4) for CCAR banks to consider the effects of large BHCs *pro forma* capital-ratio declines on large BHC lending, since these capital-ratio declines correspond to the capital buffers that large BHCs in the post-crisis capital framework need to hold in order to have coverage for forward-looking risks. When we estimate equations (3) and (4) in the context of considering what information on capital-ratio declines imply for bank lending, $Loan\ Growth$ is measured between March 2012 and March 2013, $K\ Ratio$, is a BHC's equity capital ratio in March 2012, $Reg.K\ Ratio\ Chg.$ is new regulatory information in March 2012, and all control variables, X, in equations (3) and (4) are as measured as of March 2012.

Tables 1 and 2 provide summary statistics for the variables in our regression analysis. Table 1 shows information for our sample of about 900 BHCs and Table 2 shows information for our matched firm-BHC observations corresponding to loans originated by CCAR BHCs. As seen in Table 1, the average growth rate of C&I loans (7 percent) is greater than that of total loans (4.9 percent), real estate loans (4.5 percent), and consumer loans (negative 1 percent).

The Table 1 and Figure 3 show some summary information about regulatory capital ratios as measured under different rules. As can be seen from Figure 3, for all BHCs average tier 1 capital ratio is 14.7 percent when calculated under Basel I rules for determining risks weights and qualifying capital, 13.5 percent when calculated under the BCBS's endorsed Basel III reforms, 11.7 percent when calculated under the U.S. banking agencies proposed Basel III rules, and 12.9 percent when calculated under the final Basel III rules. When in estimating equation (1) to examine what new information on the U.S. banking agencies' proposed Basel III rules imply for bank lending, if small U.S. BHCs expected that BCBS endorsed Basel III capital reforms would be applied to them when the U.S. banking agencies implemented Basel III, new information from the proposed rule would on average reduce measured regulatory capital ratios by 1.8 p.p. If instead small U.S. BHCs only expected that BCBS endorsed Basel III capital reforms would be applied to them when the U.S. banking agencies implemented Basel III new information from the proposed rule would on average reduce measured regulatory capital ratios by 3.0 p.p. When in estimating equation (1) to examine what new information on the U.S. banking agencies' final Basel III rules imply for bank lending, new information from the final rule would on average increase measured regulatory capital ratios by 1.2 p.p.

Comparing the summary statistics in Table 1 with those corresponding to the large CCAR BHCs in Table 2, we observe that on average the growth rate of C&I loans for CCAR BHCs (13 percent) was more than doubles the C&I growth rate of the other BHCs. This is consistent with the lending behavior of U.S. BHC over the last 4 years: on average C&I loans have grown at a higher rate than total loans, and this is particularly the case for the largest banks (*e.g.*, CCAR BHCs).

Table 2 also shows the summary statistics for our sample of firms borrowing from CCAR BHCs. As can be seen, the number of observations for different firm characteristics differs and is smaller than the number of observations for BHC characteristics, and this is mainly explained by the fact that not all BHCs report these data uniformly and in many cases firm-specific characteristics are not reported at all. In general, firms in our sample are smaller (average firms size is about $38 million) relative to publicly traded firms in COMPUSTAT, as our sample includes firms that are both private and publicly traded. Similarly, firms in our sample have higher leverage (43 percent relative about 20 percent on average in COMPUSTAT firms).

Figure 4 reports the decline in capital ratios in CCAR 2012, which reflects the losses, income, and capital ratios that BHCs experience under stressed conditions. For comparison we also report the capital conservation buffer and the buffer expanded by the GSIB surcharges calculated by the FSB based on the BCBS's methodology.

5. Results

5.1. BHC-level results

Table 3 shows the regression estimates of equation (1) for all BHCs on the growth rate of total loans (columns 1 and 2), C&I loans (columns 3 and 4), real estate loans (columns 4 and 5), and consumer loans (columns 7 and 8) when the variable, $Reg.K\ Ratio\ Chg.$ used in equation (1) is defined as the difference between the BHC's measured capital ratio calculated according to Basel I rules and its measured capital ratio calculated according to the U.S. banking agencies' proposed Basel III rule. As discussed, this measure of $Reg.K\ Ratio\ Chg.$ assumes that non-internationally active BHCs only realized that Basel III would be applied to them when the U.S. banking agencies proposed to adopt Basel III for all BHCs with assets greater than $0.5 billion in July 2012.

We have also estimated equation (1) with the variable, $Reg.K\ Ratio\ Chg.$ defined as the difference between the BHC's measured capital ratio calculated according to the BCBS-endorsed reforms and its measured capital ratio calculated according to the U.S. banking agencies' proposed Basel III rule, which means that non-internationally active U.S. BHCs did expect that BCBS-endorsed Basel III capital reforms

would ultimately be applied to them when the BCBS endorsed its reforms in December 2010, but as we discuss below, our results do not suggest that this was the case.

Our results in Table 3 indicate that the impact of capital on the growth rate of all different loan categories is positive and significant, suggesting that banks holding higher capital ratios lend more. Our estimates indicate that a 1 p.p. increase in the equity capital ratio is associated with 0.6 to 0.8 p.p. increase in annual growth rate of total loans (from 4.9 to 5.6 percent, on average) and between 0.7 to 0.9 p.p. increase in the annual growth rate of C&I loans (from 7 percent to 7.8 percent, on average). These results suggest an economically small impact of equity capital on BHC loan growth, and seem comparable to previous estimates discussed in section 3.1.

The impact of the measured regulatory capital-ratio change is negative. That is, the fact that BHCs measured regulatory capital ratios decline when measured in a Basel III (proposed U.S. rule) basis relative to a Basel I basis acts as a drag on loan growth. This effect is, however, only significant for real estate and consumer loans. This findings would be consistent with the fact that most of the changes in the Basel III regulatory reform were aimed at reducing mortgage lending exposures as discussed in section 2, although this explanation does not align with the fact that most of the impact of the measured regulatory capital-ratio change come through differences in the numerator of the regulatory capital ratios ($Reg.K.Rat.Chg.N$) consistent with stricter definitions on capital.

Our estimates suggest that a 1 p.p. increase in the $Reg.K.Rat.Chg.N$, that is, an unexpected reduction in the numerator of the regulatory capital ratio of 1 pp. brought by stricter definitions of capital under Basel III leads to a 0.7 p.p. reduction in the growth rate of total loans. The reduction in C&I loan growth is even larger (about 1.4 p.p.). It is worth noting that of all the bank controls in our regressions, only size and charge-offs are significant and come with the expected sign. Returns on assets (ROA) and the share of deposits in total assets are also marginally significant. As expected, an increase in net charge offs—our measure of the deterioration in BHC loan portfolios—reduce loan growth. Finally, our loan demand indicator at the BHC level, measured by the unemployment rate, is negative as expected but statistically insignificant.

Table 4 presents our regression estimates of equation (1) using the proposed rules for the growth rate of total loans and C&I loans by bank size. We split our sample of BHCs into small and large banks considering whether their total assets are below or above $1 billion in total assets, respectively. This size threshold roughly corresponds to the median in the distribution of BHC assets as of 2012:Q1. Our results indicate that the impact of the equity capital ratio on both total loan and C&I loan growth is bigger for the large banks. Accordingly, a 1 p.p. increase in the capital ratio is associated with 0.8 to 1.0 p.p. increase in total loan growth and between 1.1 and 1.4 p.p. increase in C&I loan growth. The impact of measured

regulatory capital-ratio changes are also bigger for large banks. For large banks a 1 p.p. reduction in measured regulatory capital ratios stemming from Basel III (U.S. proposed rule) definitions relative to on a Basel I definitions acts as a 0.8 p.p. drag on total loan growth rate and 0.6 p.p. drag on C&I growth. As before, however, these effects also statistically insignificant.

Reductions in measured regulatory capital ratios that stem from stricter definitions of capital under Basel III do, however, lead to statistically significant slower rates loan of loan growth. For small banks the impact of the capital ratio is only significant for total loans but not for C&I loans. In unreported regression we find that the positive impact on the loan growth of small banks is mainly driven by an increase in real estate loans. Similarly, the impact of the change in measured regulatory capital ratios on both total loans and C&I loans using the proposed rules is insignificant for small banks and this is also the case for component of measured regulator capital ratio changes that stem from changes in capital definitions.

As noted, we have also estimated equation (1) with the variable, $Reg.K\ Ratio\ Chg.$ defined as the difference between the BHC's measured capital ratio calculated according to the BCBS-endorsed reforms and its measured capital ratio calculated according to the U.S. banking agencies' proposed Basel III rule and Table 5 shows these results. This calculation of $Reg.K\ Ratio\ Chg.$ would be consistent with non-internationally active U.S. BHCs expecting that BCBS-endorsed Basel III capital reforms would ultimately be applied to them when the BCBS endorsed its reforms in December 2010. Note that because all of the differences between the Basel III reforms endorsed by the BCBS-and those included in the U.S. banking agencies' proposed Basel III rule were in the denominator of the measure we do not split out $Reg.K\ Ratio\ Chg.$, as described in equation (2), for this regression.

As shown by Table 5 when the variable, $Reg.K\ Ratio\ Chg.$ is defined as the difference between the BHC's measured capital ratio calculated according to the BCBS-endorsed reforms and its measured capital ratio calculated according to the U.S. banking agencies' proposed Basel III rule, its coefficient suggest that a reduction in measured regulatory capital ratios stemming from Basel III (U.S. proposed rule) definitions boost loan growth. This result, which is insignificant, is the opposite of what we would expect. To the extent that the results in Table 5 suggest that non-internationally active BHCs did not expect the BCBS reforms to apply to them, as a cross check we also examined whether $Reg.K\ Ratio\ Chg.$ defined as the difference between regulatory capital ratios implied by Basel I and BCBS-endorsed Basel III capital reforms and calculated in 2010:Q4 affected loan growth over 2011. Consistent with the results of Table 5 we found no significant effect.

We also study the effect of the measured regulatory capital-ratio changes under the final rules approved in July 2013. As discussed in section 2, the finalized rules were largely consistent with the initial

proposal and included amendments and modifications in response to industry feedback. In particular, compared to the initial proposed Basel III rules, the final rules provided some form of regulatory relief to smaller banks (BHC with total assets below $15 billion) consistent with the removal of the modified, differentiated system of risk weights for residential mortgages as many as these exposures are larger for smaller BHCs, and the grandfathering-in of existing "qualifying cumulative perpetual preferred stock" and "qualifying trust preferred securities" as components of tier 1 capital that were excluded from tier 1 capital in the U.S. banking agencies' proposed rule. As shown in Figure 3 on average across BHCs these modification in the final Basel III rules boosted measured regulatory capital ratios 1.2 p.p. so unwinding about 40 percent of the 3 percentage point average decrease in measured ratios that resulted from the proposed rules.

As discussed above, we measure the impact of the Basel III final rules relative to the proposed rules, and thus we estimate our regression as of 2013:Q2 and our change in measured regulatory capital ratios is given by the difference between Basel III tier 1 capital ratio under the final rule and the Basel III tier 1 capital under the proposed rule. Notice then that our regulatory change variable is positive on average as the regulatory capital ratios are bigger under the final rule compared to the ratios under the proposed rule.

Table 6 presents the results for the change in measured regulatory capital ratios measured under the final capital rules. As before, we show our estimates for the growth rate of total loans (columns 1 and 2), C&I loans (columns 3 and 4), real estate loans (columns 4 and 5), and consumer loans (columns 7 and 8). Like our findings in Tables 3 and 4, this time our results suggest a positive coefficients on the capital ratio although these coefficients are more frequently insignificant. This result seems to contradict previous findings that commercial real estate and C&I lending are more sensitive to the size of capital than other types of lending (De-Ramon, Iscenko, Osborne, Straughan, and Andrews, 2012).

For the most part our findings regarding the impact of the change in regulatory capital ratios on loan growth under final rules do not go in the direction that we might expect them to. In particular, and as explained above, because the final rules implied an increase in regulatory capital ratios, we would expect the coefficient on $Reg.K.Rat.Chg.$ to have a negative sign. We also find that the coefficients on the numerator ($Reg.K.Rat.Chg.N$) and the denominator ($Reg.K.Rat.Chg.D$) of the measured regulatory capital ratio changes tend to have positive rather than negative effects. These findings conform to the fact that most of the unexpected component in the final rules in 2013 relative to the proposed rules in 2012 was the removal of the modified and differentiated risk weights for residential mortgages and the possibility for smaller BHCs (most if which have large exposures to real estate loans) to count certain categories of capital such as qualifying

trust preferred securities as components of tier 1 capital that were excluded from tier 1 capital in the proposed rule.[16]

In fact, in unreported regressions we find that the impact of both components, $Reg.K.Rat.Chg.N$ and $Reg.K.Rat.Chg.D$, are only significant for the real estate lending of small banks. A possible explanation for the lack of significance of both the capital ratio and the measured regulatory capital ratio change on C&I lending is that by the time the rules were finalize banks had already completed most of the adjustment in their holdings of capital, and were operating with large capital buffers which, consistent with Carlson et al (2013), would imply that the impact of the "additional" regulation, which mostly affected real estate loans, was also smaller as banks could have comfortably met most of the new Basel III capital requirements.[17]

Table 7 shows the results of the equity capital and the change in measured regulatory capital ratios under final rules on total loan and C&I loan growth by bank size. The impact of capital is positive and significant only for the total loan growth of small BHCs. Similarly, for the large BHCs, we find that the negative and significant coefficient of the change in measured regulatory capital ratios on loan growth is mainly reflected as a positive effect on the growth real of real estate loans (not shown) and is essentially driven by the differences in the denominator ($Reg.K.Rat.Chg.D$), consistent with the view of a regulatory relief provided by the final Basel III rules, especially in terms of the removal of the modified, differentiated system of risk weights for residential mortgages. As before, we find no significant impact of capital or the change in measured regulatory capital ratios on C&I loan growth of neither large nor small banks.

In short, our first approach suggests a positive and significant effect of equity capital on total loan growth. The effect may seem relatively small and comparable to previous estimates. We find that the positive impact of regulatory capital on C&I loan growth occurs only at large banks. We find a negative effect of the change in measured regulatory capital ratios on loan growth when we use the proposed capital rules. Most of the effect reflects the reduction in the numerator of the capital ratio, consistent with a tougher definition of capital under Basel III. We find limited evidence of a positive impact of changes in measured regulatory capital ratios under the Basel III final rules on loan growth.

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[16] Another reason why the positive effect on bank capital from the final rules may not have had an effect on bank lending is that the changes they entailed might have been already been anticipated. The text of the testimony noted earlier in footnote 6 made mention specific mention of the fact that comments highlighting operational complexity were received about the proposed rule's varying residential loan risk weights and that the Board and other banking agencies would be re-considering this aspect of the rule as they finalized it.

[17] Carlson et al (2013) find that the impact of stricter capital regulation (e.g. higher capital requirements) is bigger when banks operate with small capital buffers, that is, with capital holdings close to the minimum requirements.

5.2. BHC C&I loan-level results

In this section we use information from the corporate regulatory schedule of the FR-Y14 report, which allows us to construct a matched firm-BHC dataset with utilized corporate loans (C&I loans) by the 18 CCAR BHCs as of March 2012 and 30 BHCs as of March 2013. As before, we examine the impact of both higher capital ratios and the regulatory changes associated with the capital declines under stress on BHC one-year loan growth and follow an identification approach similar to that in Khwaja and Mian (2008).

Table 8 shows our regression estimates of equations (3) and (4) for the impact of equity capital and the changes in regulatory capital ratios under stress on the loan growth of CCAR BHCs. Columns 1 and 2 use model specifications with firm fixed-effects as in equation (3) on multi-bank firms and all firms respectively, when loan growth is measured as the 4-quarter change in C&I loans as of March 2012. Columns 3 through 5 use loan growth measured as the 4-quarter change in C&I loans as of June 2012. The reason for including these additional columns is that banks consistently report financial information of their borrowers in the FRY-14 schedule, which we need for the OLS estimation of equation (4), only starting in June 2012. Thus, Columns 3 and 4 use similar firm fixed-effect specifications on multi-bank firms and all firms respectively, and column 5 shows the OLS estimation of equation (4) on all firms including firm controls as of June 2012. We find a positive and significant impact of the equity capital ratio on BHC loan growth across all regression specifications. The effect is considerably larger than the estimates using our first approach in the sample of 900 BHCs. After controlling for loan demand in a matched sample of lenders and borrowers we find significant effects of bank capital on C&I lending.

The firm fixed-effect estimation on multibank firms is our preferred estimation though, as discussed above, it is the most restrictive specification and uses only about 4000 multibank firms. However, as in Khwaja and Mian (2008), the fixed-effect regression provides an unbiased estimate of the impact of the implementation of Basel III capital regulation to the extent that the within firm comparison fully absorbs the firm-specific changes in loan demand. Our results in columns 1 through 4 considering multibank and all firms indicate that a 1 percentage point increase in Basel III capital ratios leads to a 5 to 7 percentage point increase in BHC's 4-quarter C&I loan growth to a firm. This effect seems larger in columns 3 and 4, that is, when loan growth is measured as of June 2012. Moreover, the effect seem to be robust to including the single-bank firms without firm fixed effects in column 5.

As in the previous analysis using the sample of 900 BHCs, our results using the CCAR banks show a negative and significant coefficient on the regulatory capital changes measured by the capital buffer under stress. This finding is somewhat consistent with our previous estimation, though as in the case of the impact of capital, the impact of $Reg.K.Rat.Chg.$ is substantially larger, somewhat consistent with the larger effects

27

we found for the group of large banks before. The within firm fixed effect estimation in column 1, our most preferred approach, suggests that a 1 percentage point increase in $Reg.K.Rat.Chg.$ leads to about 3 percentage point contraction in C&I loan growth. The negative effect using firm fixed effect specifications seems larger (about 8 percentage points) when we measure the 4-quarter loan growth as of June 2012. In this latter case, the OLS estimation in column 5 shows a lower coefficient on the regulatory capital buffer under stress. Despite the fact that the coefficients on the OLS estimation are statistically significant, we are somewhat less confident of this result as it could be an artifact of the shrinkage of the dataset due to missing data on firm-specific characteristics.

We also consider the impact of the regulatory capital buffer under stress augmented by the countercyclical capital buffer (CCB) and individual GSIB surcharges in Tables 9 and 10 respectively. As before, the effect of capital is positive and significant, and slightly larger. Our findings considering the capital buffer under stress expanded by extra layers of regulation suggest that a 1 percentage point increase in equity capital lead to a 6 to 12 percentage point increase in BHC's 4-quarter loan growth. The negative effect of the regulatory capital buffers, however, are significant but considerably smaller now. A 1 percentage point increase in $Reg.K.Rat.Chg.$ leads to less than 1 percentage point contraction in C&I loan growth. This significantly smaller impact of the regulatory capital ratio change is explained by the fact that the potential unanticipated component of the forward-looking capital buffer is smaller as we consider extra layers of regulation such as the CCB and the GSIB surcharges. For example, the regulatory capital buffer under stress after considering both the CCB and the GSIB surcharges is zero for a number of CCAR BHCs. As a result, the amount of capital buffers the BHCs would be required to meet the minimum requirements to hold are also smaller.

In summary, our findings using the firm-level data on C&I lending of CCAR BHCs suggest a strong effect of both the capital ratio and the change in regulatory capital ratios under stress. Compared to our estimates using the 900 BHCs, the effect of capital and the regulatory capital ratio changes implied by the stress tests on C&I loan growth are much larger for the CCAR BHCs.

5.3. Robustness

As a robustness exercise in estimating the impact of capital and regulatory capital-ratio changes, we replace our equity capital ratio in equation (1) with a capital surplus (or shortfall) measure, following Berrospide and Edge (2010) and Hancock and Wilcox (1993, 1994).[18] For that purpose, we consider deviations of equity

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[18] Hancock and Wilcox (1993) argue that for U.S. banks, their internal capital targets seem to explain changes in bank lending more accurately than actual capital requirements. The use of capital surplus in place of the equity capital ratios in equation (1) also helps to mitigate potential endogeneity of equity capital caused by reverse causality between the capital

capital relative to a target capital ratio (k*). Using a partial-adjustment model between actual and target capital holdings, we estimate individual BHC capital targets as a linear function of a vector of bank controls aimed at capturing specific characteristics of individual BHC's business model such as size, earnings and risks.[19] Estimates of the coefficients in the target capital ratio equation are then used to calculate individual BHC's target capital ratios, and these, in turn, used to construct a capital surplus measure denoted by

$$Z_i = \frac{K_i - K_t^*}{Assets_i} \tag{5}$$

Tables 9 and 10 show the estimates of equation (1) using our estimates of a capital surplus according to equation (5) in place of the capital ratios for all BHCs using the proposed rules and the final rules, respectively. Our estimates of the impact of both capital and changes in regulatory capital ratios in Tables 9 and 3 are very similar, suggesting that our results using the proposed rules are robust to the specification of the capital ratio. Interestingly now, comparing our estimates in Tables 10 and 6 using the final rules, we observe that in Table 10 our measure of capital surplus is now significant for all loan categories, except consumer loans. In particular, capital surplus is positive and significant for C&I loan growth, suggesting even a slightly larger effect than before. We also find, as before, that the $Reg. K. Rat. Chg.$ measure under final rules is in most cases insignificant, corroborating that the impact of the unexpected components of the Basel III final rule relative to the proposed rules seems to be negligible for the average BHC.

6. Concluding remarks

Motivated by number of financial reforms that followed as a regulatory response to the 2007-2009 financial crisis, and the availability of loan-level data for the largest U.S. BHCs, this paper revisits the question of the effects of regulatory bank capital on lending from the perspective of the U.S. economy's experience in implementing regulatory capital reforms. We perform our analysis separately for small BHCs, for which Basel III represents the main post-crisis change in their capital regime, and for the largest BHCs subject to additional post-crisis reforms. In both cases we use the arrival of new information on capital requirements to estimate these impacts.

For smaller BHCs, and consistent with previous results using bank-level data, we find a positive but relatively small impact of bank capital on lending, for various categories of loans and even after controlling for BHC-

ratio and loan growth. More specifically, to the extent that bank's decisions on how much capital to hold reflects asset risk due to past lending decisions, one could argue that the capital ratio is endogenous. By construction, the capital surplus variable reflects capital buffers over a predicted target capital measure which already accounts for asset risks due to past lending decisions.

[19] In particular, we model a target capital ratio that depends on bank assets, return on assets, net charge-offs, and the asset mix captured by the share of liquid assets and different loan categories in the BHC's balance sheet.

level loan demand. The impact of capital seems much larger when we control for loan demand using a BHC-firm matched sample of the largest CCAR BHCs.

For the smaller BHCs, we also examine the impact of the implementation of Basel III capital regulation through the new proposed capital rules announced in the U.S. in 2012 and finalized 2013. We interpret these announcements as conveying new information about capital requirements and risk weights that surprised banks and allowed them to determine the difference between current and new Tier 1 capital ratios. We expect that in closing the regulatory gap, banks adjust their lending policies and thus affect their loan growth after the announcements. Consistent with our hypothesis, we find a negative and significant effect of the regulatory capital-ratio change on loan growth. Our findings suggest that the impact of the new capital regulation on lending could have been more binding under the initial proposed rules.

The negative impact of the $Reg. K. Rat. Chg.$ under stress is considerably larger when we control for loan demand using a BHC-firm matched sample of the largest CCAR BHCs. One interpretation of the considerably larger impact for the largest CCAR BHCs is that, unlike small BHCs which were mostly well capitalized before the regulatory reforms, large BHCs were operating with lower capital ratios and thus the news about higher capital requirements implied by the post-crisis regulatory reforms have led these banks to raise significantly large amounts of capital to meet the stricter capital requirements, which have had considerable effects on their lending decisions.

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Table 1: Summary Statistics - All BHCs

This table provides summary statistics for all balance sheet variables in the regression analysis that use U.S. BHCs with total assets between $0.5 billion and $50 billion subject to Basel III capital regulation (non-CCAR BHCs) as of June 2012. B3 tier1 capital ratio corresponds to the Basel III tier 1 capital ratio according to the proposed rules. Reg. K ratio change is the difference between Basel I and Basel III tier 1 capital ratios. Reg. K ratio change N and Reg. K ratio change D are the changes in the numerator and denominator of the tier 1 capital ratio between the Basel I and Basel III capital frameworks, respectively. Unemployment rate is the BHC-specific unemployment rate calculated using state-level unemployment rates weighted by BHC's state-level deposits. Source: FR Y-9C and FDIC Summary of Deposits.

Variable	Obs.	Mean	Std. Dev.	Min	Max
Total Loan growth	883	0.049	0.114	-0.221	0.522
C&I Loan growth	882	0.070	0.215	-0.496	0.939
RE Loan growth	882	0.045	0.130	-0.303	0.607
Consumer Loan growth	876	-0.012	0.286	-0.870	1.206
B1 Tier1 Capital ratio	883	0.148	0.056	0.016	0.534
B3 Tier1 Capital ratio	883	0.119	0.052	0.003	0.447
Reg. K ratio change	883	0.030	0.017	-0.049	0.129
Reg. K ratio change N	883	0.010	0.017	-0.070	0.117
Reg. K ratio change D	883	0.019	0.011	0.000	0.115
Size (log Total assets)	883	14.16	1.05	13.13	19.56
Equity / TA	883	0.102	0.03	0.01	0.41
ROA	883	0.81	1.09	-7.96	13.64
Deposit / TA	883	0.305	0.124	0.028	0.778
Liq. Asset / TA	883	0.81	0.09	0.08	0.97
charge-off / TA	883	0.43	0.68	-0.73	7.69
Unemployment rate	816	7.66	1.45	3.03	10.72

Table 2: Summary Statistics - CCAR BHCs

This table provides summary statistics for all balance sheet variables in the BHC-firm level regression analysis that use all U.S. BHCs in the Comprehensive Capital Analysis Review (CCAR) as of June 2012. B3 tier1 capital ratio corresponds to the Basel III tier 1 capital ratio according to the proposed rules. Reg. K ratio change is the difference between Basel I and Basel III tier 1 capital ratios. Reg. K ratio change N and Reg. K ratio change D are the changes in the numerator and denominator of the tier 1 capital ratio between the Basel I and Basel III capital frameworks, respectively. Firm-level variables other than Size are expressed as ratios of total assets (TA). Leverage is defined as Debt/TA. Source: FR Y-9C and FR Y-14 data (Corporate schedule).

Variable	Obs.	Mean	Std. Dev.	Min	Max
CCAR BHC VARIABLES					
Total Loan growth	45,010	0.143	0.803	-2.500	2.705
B1 Tier1 Capital ratio	45,010	0.125	0.020	0.094	0.172
B3 Tier1 Capital ratio	45,010	0.091	0.009	0.076	0.150
Reg. K ratio change	45,010	0.029	0.009	0.001	0.056
Reg. K ratio change N	45,010	0.011	0.008	-0.002	0.037
Reg. K ratio change D	45,010	0.018	0.003	0.003	0.024
Reg. K ratio Stress change	45,010	0.033	0.013	-0.008	0.066
Size (log Total assets)	45,010	20.220	1.149	18.278	21.552
ROA	45,010	0.007	0.010	-0.019	0.017
Equity / TA	45,010	0.110	0.013	0.078	0.134
Deposit / TA	45,010	0.586	0.157	0.091	0.777
Liq. Asset / TA	45,010	0.267	0.080	0.165	0.492
charge-off / TA	45,010	0.564	0.201	0.000	1.001
Firm Variable					
Size (log Total assets)	31,526	10.590	3.085	1.233	18.736
Cash / TA	31,296	0.085	0.113	0.000	0.673
Ebitda / TA	30,809	0.135	0.170	-0.127	1.198
Leverage	31,155	0.415	0.280	0.000	1.271
Sales / TA	31,207	2.389	1.947	0.053	10.815
Rating A Dummy	43,174	0.032	0.176	0.000	1.000
Rating B Dummy	43,174	0.769	0.422	0.000	1.000
Rating C Dummy	43,174	0.044	0.205	0.000	1.000
Rating D Dummy	43,174	0.010	0.099	0.000	1.000

Table 3: Effect of Bank Capital and Proposed Regulatory Capital Ratio Change on Loan Growth: ALL BHCs.

This table reports the estimation results of cross-section equation (1) for all non-CCAR BHCs subject to Basel III capital rules, by type of loan (total, consumer and industrial (C&I), real estate, and consumer). Reg. K ratio change is the difference between Basel I and Basel III tier 1 capital ratios according to the proposed rules. Reg. K ratio change N and Reg. K ratio change D are the changes in the numerator and denominator of the tier 1 capital ratio between the Basel I and Basel III capital frameworks, respectively. Unemployment rate is the BHC-specific unemployment rate calculated using state-level unemployment rates weighted by BHC's state-level deposits. Robust standard errors are indicated in brackets. ***, **, and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

ALL BANKS	Total Loans		C&I Loans		Real Estate Loans		Consumer Loans	
Vars	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Equity Capital ratio	0.752***	0.616***	0.930**	0.661*	0.631***	0.466**	1.213***	0.772*
	[0.194]	[0.196]	[0.383]	[0.393]	[0.218]	[0.225]	[0.443]	[0.430]
Reg. K ratio change (proposed rule)	-0.527*		-0.734		-0.778**		-1.587**	
	[0.301]		[0.582]		[0.303]		[0.712]	
Reg. K ratio change N		-0.786***		-1.451***		-0.839***		-1.758***
		[0.233]		[0.487]		[0.281]		[0.665]
Reg. K ratio change D		0.08		0.06		-0.13		-0.159
		[0.115]		[0.220]		[0.122]		[0.258]
Size	0.015***	0.015***	0.019**	0.020***	0.008	0.010*	0.025**	0.027**
	[0.004]	[0.004]	[0.008]	[0.008]	[0.005]	[0.006]	[0.012]	[0.012]
ROA	0.006	0.007	0.006	0.007	0.010**	0.009*	0.002	0.002
	[0.004]	[0.004]	[0.010]	[0.009]	[0.005]	[0.005]	[0.012]	[0.013]
Deposit / TA	0.103*	0.089	-0.011	-0.037	-0.057	-0.056	0.008	0.007
	[0.060]	[0.056]	[0.196]	[0.190]	[0.123]	[0.120]	[0.167]	[0.167]
Liq. Asset / TA	-0.028	-0.039	-0.05	-0.078	-0.022	-0.045	-0.09	-0.132
	[0.035]	[0.038]	[0.065]	[0.071]	[0.040]	[0.044]	[0.090]	[0.095]
Net Charge-off / TA	-0.027**	-0.027**	-0.033*	-0.033*	-0.025**	-0.024**	-0.003	-0.002
	[0.012]	[0.012]	[0.019]	[0.018]	[0.012]	[0.012]	[0.029]	[0.029]
Unemployment rate	-0.004	-0.004	-0.003	-0.003	-0.003	-0.003	-0.01	-0.01
	[0.003]	[0.003]	[0.005]	[0.005]	[0.003]	[0.003]	[0.007]	[0.007]
Constant	-0.259***	-0.252***	-0.213	-0.195	-0.029	-0.019	-0.344	-0.331
	[0.094]	[0.091]	[0.244]	[0.239]	[0.146]	[0.142]	[0.228]	[0.229]
Observations	816	816	815	815	815	815	811	811
R-squared	0.11	0.12	0.05	0.06	0.09	0.09	0.04	0.04

Table 4: Effect of Bank Capital and Proposed Regulatory Capital Ratio Change on Loan Growth: Large and Small BHCs.

This table reports the estimation results of cross-section equation (1) for large and small BHCs subject to Basel III capital rules. Large (small) BHCs are those above (below) the median in the size (log of total assets) distribution. Reg. K ratio change is the difference between Basel I and Basel III tier 1 capital ratios, according to the proposed rules. Reg. K ratio change N and Reg. K ratio change D are the changes in the numerator and denominator of the tier 1 capital ratio between the Basel I and Basel III capital frameworks, respectively. Unemployment rate is the BHC-specific unemployment rate calculated using state-level unemployment rates weighted by BHC's state-level deposits. Robust standard errors are indicated in brackets. ***, **, and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

	Large Banks				Small Banks			
	Total Loans		C&I Loans		Total Loans		C&I Loans	
Vars	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Equity Capital ratio	1.006***	0.779**	1.437**	1.139**	0.504**	0.433*	0.273	0.006
	[0.325]	[0.303]	[0.586]	[0.535]	[0.218]	[0.244]	[0.529]	[0.596]
Reg. K ratio change (proposed rule)	-0.796*		-0.599		-0.441		-1.233	
	[0.469]		[0.859]		[0.336]		[0.833]	
Reg. K ratio change N		-1.302***		-2.032***		-0.374		-1.098
		[0.330]		[0.634]		[0.339]		[0.816]
Reg. K ratio change D		0.185		0.474		-0.076		-0.492*
		[0.170]		[0.298]		[0.117]		[0.266]
Size	0.003	0.003	-0.002	-0.004	0.026	0.026	0.037	0.036
	[0.006]	[0.006]	[0.012]	[0.012]	[0.024]	[0.024]	[0.052]	[0.051]
ROA	0.005	0.007	0.007	0.011	0.006	0.006	0.006	0.002
	[0.005]	[0.005]	[0.011]	[0.010]	[0.007]	[0.007]	[0.018]	[0.018]
Deposit / TA	0.116	0.091	-0.09	-0.149	0.064	0.066	0.132	0.138
	[0.079]	[0.070]	[0.260]	[0.241]	[0.098]	[0.098]	[0.255]	[0.249]
Liq. Asset / TA	-0.039	-0.063	-0.057	-0.098	-0.021	-0.033	-0.018	-0.073
	[0.057]	[0.062]	[0.094]	[0.105]	[0.042]	[0.044]	[0.094]	[0.096]
Net Charge-off / TA	-0.032	-0.034*	-0.044	-0.048*	-0.024**	-0.023**	-0.026	-0.025
	[0.022]	[0.020]	[0.033]	[0.029]	[0.012]	[0.012]	[0.022]	[0.023]
Unemployment rate	0.001	0.001	0.001	0	-0.008**	-0.008**	-0.006	-0.006
	[0.004]	[0.004]	[0.008]	[0.007]	[0.004]	[0.004]	[0.007]	[0.007]
Constant	-0.138	-0.119	0.088	0.131	-0.333	-0.323	-0.489	-0.389
	[0.130]	[0.118]	[0.360]	[0.334]	[0.346]	[0.348]	[0.758]	[0.758]
Observations	399	399	399	399	417	417	416	416
R-squared	0.11	0.14	0.08	0.12	0.09	0.09	0.03	0.03

Table 5: Effect of Bank Capital and GHOS Regulatory Capital Ratio Change on Loan Growth: ALL BHCs.

This table reports the estimation results of cross-section equation (1) for all BHCs subject to Basel III capital rules, by type of loan (total, consumer and industrial (C&I), real estate, and consumer). Reg. K ratio change GHOS is the difference between GHOS and Basel III tier 1 capital ratios according to the proposed rules. Unemployment rate is the BHC-specific unemployment rate calculated using state-level unemployment rates weighted by BHC's state-level deposits. Robust standard errors are indicated in brackets. ***, **, and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

ALL BANKS	Total	C&I	Real Estate	Consumer
Vars	(1)	(2)	(3)	(4)
Equity Capital ratio	0.750***	0.911**	0.618***	1.166**
	[0.199]	[0.389]	[0.227]	[0.455]
Reg. K ratio GHOS (proposed rule)	0.181	0.189	-0.003	0.113
	[0.114]	[0.229]	[0.128]	[0.264]
Size	0.013***	0.016**	0.007	0.021*
	[0.004]	[0.008]	[0.006]	[0.012]
ROA	0.008*	0.008	0.011**	0.004
	[0.004]	[0.009]	[0.005]	[0.013]
Deposit / TA	0.106*	-0.002	-0.036	0.044
	[0.058]	[0.194]	[0.123]	[0.164]
Liq. Asset / TA	-0.006	-0.024	-0.012	-0.058
	[0.038]	[0.068]	[0.042]	[0.095]
Net Charge-off / TA	-0.027**	-0.033*	-0.024**	-0.003
	[0.012]	[0.018]	[0.012]	[0.028]
Unemployment rate	-0.005*	-0.004	-0.004	-0.011
	[0.003]	[0.005]	[0.003]	[0.007]
Constant	-0.279***	-0.24	-0.045	-0.386*
	[0.093]	[0.243]	[0.146]	[0.231]
Observations	816	815	815	811
R-squared	0.11	0.05	0.08	0.03

Table 6: Effect of Bank Capital and Final Regulatory Capital Ratio Change on Loan Growth: ALL BHCs.

This table reports the estimation results of cross-section equation (1) for all BHCs subject to Basel III capital rules, by type of loan (total, consumer and industrial (C&I), real estate, and consumer). Reg. K ratio change is the difference between Basel III capital ratios under proposed and final rules. Reg. K ratio change N and Reg. K ratio change D are the changes in the numerator and denominator of the tier 1 capital ratio between the Basel III proposed and final rules, respectively. Unemployment rate is the BHC-specific unemployment rate calculated using state-level unemployment rates weighted by BHC's state-level deposits. Robust standard errors are indicated in brackets. ***, **, and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

ALL BANKS	Total Loans		C&I Loans		Real Estate Loans		Consumer Loans	
Vars	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Equity Capital ratio	0.527***	0.486***	0.504	0.475	0.685***	0.645**	0.431	0.4
	[0.173]	[0.180]	[0.357]	[0.352]	[0.240]	[0.251]	[0.464]	[0.466]
Reg. K ratio change (final rule)	0.732**		-0.012		0.897**		-0.029	
	[0.347]		[0.611]		[0.395]		[0.949]	
Reg. K ratio change N		0.721*		0.416		0.718		0.786
		[0.381]		[0.652]		[0.446]		[1.008]
Reg. K ratio change D		0.246		-0.426		0.479**		-1.095*
		[0.172]		[0.365]		[0.201]		[0.561]
Size	0.016***	0.015***	0.027***	0.029***	0.008	0.007	0.023*	0.026**
	[0.004]	[0.004]	[0.008]	[0.008]	[0.005]	[0.005]	[0.014]	[0.013]
ROA	0.014***	0.013***	0.012**	0.012***	0.011**	0.011**	0.022*	0.023**
	[0.005]	[0.005]	[0.005]	[0.005]	[0.005]	[0.005]	[0.011]	[0.011]
Deposit / TA	0.1	0.095	0.095	0.1	0.09	0.081	-0.019	0.023
	[0.083]	[0.083]	[0.097]	[0.096]	[0.077]	[0.077]	[0.185]	[0.191]
Liq. Asset / TA	-0.092***	-0.101***	-0.156**	-0.140**	-0.120***	-0.137***	-0.102	-0.068
	[0.032]	[0.032]	[0.061]	[0.061]	[0.038]	[0.039]	[0.088]	[0.087]
Net Charge-off / TA	-0.045***	-0.045***	-0.042**	-0.041*	-0.051***	-0.051***	-0.043**	-0.041**
	[0.009]	[0.009]	[0.021]	[0.021]	[0.010]	[0.010]	[0.019]	[0.019]
Unemployment rate	0.001	0.001	0.011**	0.009*	-0.001	0	0.01	0.006
	[0.003]	[0.003]	[0.005]	[0.005]	[0.003]	[0.003]	[0.008]	[0.008]
Constant	-0.234**	-0.218*	-0.430***	-0.461***	-0.11	-0.076	-0.357	-0.469
	[0.110]	[0.112]	[0.157]	[0.157]	[0.113]	[0.114]	[0.291]	[0.297]
Observations	813	813	812	812	812	812	805	805
R-squared	0.11	0.11	0.05	0.05	0.09	0.09	0.02	0.03

Table 7: Effect of Bank Capital and Final Regulatory Capital Ratio Change on Loan Growth: Large and Small BHCs.

This table reports the estimation results of cross-section equation (1) for large and small BHCs subject to Basel III capital rules. Large (small) BHCs are those above (below) the median in the size (log of total assets) distribution. Reg. K ratio change is the difference between Basel III capital ratios under proposed and final rules. Reg. K ratio change N and Reg. K ratio change D are the changes in the numerator and denominator of the tier 1 capital ratio between the Basel III proposed and final rules, respectively. Unemployment rate is the BHC-specific unemployment rate calculated using state-level unemployment rates weighted by BHC's state-level deposits. Robust standard errors are indicated in brackets. ***, **, and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

	Large Banks				Small Banks			
	Total Loans		C&I Loans		Total Loans		C&I Loans	
Vars	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Equity Capital ratio	0.685**	0.639*	0.809	0.837	0.375**	0.351**	0.293	0.235
	[0.337]	[0.337]	[0.667]	[0.659]	[0.162]	[0.169]	[0.437]	[0.426]
Reg. K ratio change (final rule)	0.926*		0.088		0.672*		-0.04	
	[0.549]		[0.729]		[0.398]		[0.991]	
Reg. K ratio change N		1.079*		0.85		0.606		0.283
		[0.617]		[0.849]		[0.429]		[1.061]
Reg. K ratio change D		0.155		-0.717		0.214		-0.385
		[0.309]		[0.488]		[0.170]		[0.531]
Size	0	0	0.004	0.004	0.057***	0.055***	0.109**	0.115**
	[0.008]	[0.007]	[0.011]	[0.011]	[0.021]	[0.021]	[0.050]	[0.051]
ROA	0.007	0.008	0.007	0.007	0.027***	0.026***	0.018	0.019
	[0.006]	[0.006]	[0.005]	[0.004]	[0.004]	[0.004]	[0.013]	[0.013]
Deposit / TA	0.083	0.081	-0.018	-0.021	0.106	0.1	0.284	0.303*
	[0.115]	[0.114]	[0.117]	[0.116]	[0.086]	[0.085]	[0.180]	[0.176]
Liq. Asset / TA	-0.075	-0.08	-0.133	-0.109	-0.089**	-0.099***	-0.158*	-0.139*
	[0.052]	[0.053]	[0.091]	[0.090]	[0.035]	[0.035]	[0.082]	[0.082]
Net Charge-off / TA	-0.040***	-0.040***	-0.017	-0.018	-0.041***	-0.041***	-0.058*	-0.056*
	[0.014]	[0.014]	[0.026]	[0.026]	[0.009]	[0.009]	[0.030]	[0.030]
Unemployment rate	0.004	0.004	0.009	0.008	0	0.001	0.013*	0.012*
	[0.005]	[0.004]	[0.007]	[0.007]	[0.003]	[0.003]	[0.007]	[0.007]
Constant	-0.02	-0.011	-0.011	-0.029	-0.797***	-0.759**	-1.689**	-1.796**
	[0.171]	[0.171]	[0.213]	[0.213]	[0.308]	[0.302]	[0.696]	[0.710]
Observations	394	394	394	394	419	419	418	418
R-squared	0.07	0.07	0.04	0.05	0.15	0.15	0.05	0.05

Table 8: Effect of Bank Capital and Regulatory Capital Ratio Change on Loan Growth of CCAR BHCs

This table reports the estimation results of cross-section equations (3) and (4) for all CCAR BHCs. In columns (1) and (2) loan growth is measured between 2012:Q1 an 2013:Q1. In columns (3) through (5) loan growth is measured between 2012:Q2 to 2013:Q2. Reg. K ratio change is the capital buffer under stress measured by the capital decline in the severely adverse scenario of the 2012 CCAR stress test. Robust standard errors are indicated in brackets. ***, **, and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Variable	FE	FE	FE	FE	OLS
	(1)	(2)	(3)	(4)	(5)
Equity Capital ratio	5.001***	4.620**	6.666***	7.100***	10.918***
	[1.135]	[2.174]	[1.282]	[2.527]	[0.733]
Reg. K ratio change (Stress)	-3.356***	-3.193*	-7.856***	-7.883***	-3.424***
	[0.850]	[1.673]	[1.278]	[2.505]	[1.036]
Bank Size	0.061*	0.075	-0.072**	-0.069	-0.111***
	[0.033]	[0.062]	[0.032]	[0.059]	[0.019]
Bank ROA	-14.727***	-16.462**	-23.617***	-24.390**	2.297
	[3.425]	[6.650]	[5.829]	[11.311]	[4.286]
Bank Deposit / TA	-1.004***	-0.827*	-0.737**	-0.668	-1.603***
	[0.238]	[0.450]	[0.308]	[0.588]	[0.216]
Bank Liq. Asset / TA	-0.568**	-0.449	0.584**	0.719	0.688***
	[0.238]	[0.451]	[0.262]	[0.489]	[0.200]
Bank Net Charge-off / TA	0.176***	0.200*	0.289***	0.318**	0.477***
	[0.055]	[0.105]	[0.069]	[0.132]	[0.050]
Large Bank Dummy	0.019	0.008	0.667***	0.696***	0.533***
	[0.091]	[0.176]	[0.092]	[0.170]	[0.060]
Inv. Bank Dummy	-0.251**	-0.183	0.383**	0.449	0.023
	[0.092]	[0.178]	[0.175]	[0.336]	[0.128]
Regional Bank Dummy	0.044	0.053	0.428***	0.454***	0.198***
	[0.060]	[0.116]	[0.070]	[0.133]	[0.046]
Firm Size					0.006**
					[0.003]
Firm Cash/ TA					0.073
					[0.051]
Firm Ebitda					0.063*
					[0.036]
Firm Leverage					-0.139***
					[0.022]
Firm Sales / TA					0.012***
					[0.003]
Firm Rating A Dummy					0.069
					[0.052]
Firm Rating B Dummy					0.138***
					[0.034]
Firm Rating C Dummy					-0.095**
					[0.038]
Firm Rating D Dummy					-0.395***
					[0.061]
Constant	-0.723	-1.16	0.946	0.698	1.400***
	[0.661]	[1.227]	[0.642]	[1.195]	[0.345]
Observations	9329	45069	9285	45010	30498
Firm Fixed Effects	Yes	Yes	Yes	Yes	No
Multi-bank firms Only	Yes	No	Yes	No	No
R-squared	0.77	0.93	0.77	0.93	0.07

Table 9: Effect of Bank Capital and Regulatory Capital Ratio Change on Loan Growth of CCAR BHCs

This table reports the estimation results of cross-section equations (3) and (4) for all CCAR BHCs. In columns (1) and (2) loan growth is measured between 2012:Q1 an 2013:Q1. In columns (3) through (5) loan growth is measured between 2012:Q2 to 2013:Q2. Reg. K ratio change is the capital buffer under stress measured by the capital decline in the severely adverse scenario of the 2012 CCAR stress test augmented by the Countercyclical Capital Buffer (CCB). Robust standard errors are indicated in brackets. ***, **, and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Variable	FE	FE	FE	FE	OLS
	(1)	(2)	(3)	(4)	(5)
Equity Capital ratio	6.395***	5.897**	10.124***	10.600***	12.486***
	[1.232]	[2.339]	[1.275]	[2.493]	[0.724]
Reg. K ratio change (Stress & CCB)	-0.057***	-0.055*	-0.092***	-0.095***	-0.046***
	[0.016]	[0.031]	[0.016]	[0.031]	[0.013]
Bank Size	0.031	0.048	-0.105***	-0.106*	-0.129***
	[0.037]	[0.069]	[0.033]	[0.063]	[0.021]
Bank ROA	-8.827**	-10.814	-2.318	-3.089	11.209***
	[3.563]	[6.872]	[4.059]	[7.892]	[2.421]
Bank Deposit / TA	-1.348***	-1.156**	-1.743***	-1.694***	-2.082***
	[0.266]	[0.499]	[0.273]	[0.513]	[0.155]
Bank Liq. Asset / TA	-0.319	-0.225	0.796***	0.930*	0.778***
	[0.253]	[0.475]	[0.269]	[0.501]	[0.209]
Bank Net Charge-off / TA	0.147***	0.17	0.269***	0.289**	0.453***
	[0.057]	[0.110]	[0.070]	[0.136]	[0.054]
Large Bank Dummy	0.106	0.088	0.422***	0.456***	0.430***
	[0.100]	[0.190]	[0.069]	[0.127]	[0.041]
Inv. Bank Dummy	-0.292***	-0.223	-0.183	-0.12	-0.230***
	[0.091]	[0.175]	[0.133]	[0.251]	[0.089]
Regional Bank Dummy	0.105*	0.112	0.206***	0.231**	0.106***
	[0.061]	[0.117]	[0.057]	[0.109]	[0.037]
Firm Size					0.006**
					[0.003]
Firm Cash/ TA					0.073
					[0.051]
Firm Ebitda					0.062*
					[0.036]
Firm Leverage					-0.139***
					[0.022]
Firm Sales / TA					0.011***
					[0.003]
Firm Rating A Dummy					0.062
					[0.052]
Firm Rating B Dummy					0.129***
					[0.034]
Firm Rating C Dummy					-0.103***
					[0.039]
Firm Rating D Dummy					-0.402***
					[0.061]
Constant	-0.291	-0.763	1.661**	1.503	1.821***
	[0.730]	[1.345]	[0.678]	[1.263]	[0.389]
Observations	9329	45069	9285	45010	30498
Firm Fixed Effects	Yes	Yes	Yes	Yes	No
Multi-bank firms Only	Yes	No	Yes	No	No
R-squared	0.76	0.93	0.77	0.93	0.07

Table 10: Effect of Bank Capital and Regulatory Capital Ratio Change on Loan Growth of CCAR BHCs

This table reports the estimation results of cross-section equations (3) and (4) for all CCAR BHCs. In columns (1) and (2) loan growth is measured between 2012:Q1 an 2013:Q1. In columns (3) through (5) loan growth is measured between 2012:Q2 to 2013:Q2. Reg. K ratio change is the capital buffer under stress measured by the capital decline in the severely adverse scenario of the 2012 CCAR stress test augmented by the Countercyclical Capital Buffer (CCB) and individual GSIB surcharges. Robust standard errors are indicated in brackets. ***, **, and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Variable	FE	FE	FE	FE	OLS
	(1)	(2)	(3)	(4)	(5)
Equity Capital ratio	6.333***	5.776**	11.627***	12.230***	12.198***
	[1.313]	[2.472]	[1.389]	[2.698]	[0.823]
Reg. K ratio change (Stress + CCB + GSIB)	-0.050***	-0.046	-0.104***	-0.110***	-0.018
	[0.019]	[0.036]	[0.020]	[0.039]	[0.015]
Bank Size	0.057	0.076	-0.105***	-0.109*	-0.103***
	[0.037]	[0.068]	[0.035]	[0.065]	[0.022]
Bank ROA	-11.127***	-13.195*	-0.504	-1.453	13.367***
	[3.503]	[6.745]	[4.020]	[7.827]	[2.346]
Bank Deposit / TA	-1.151***	-0.956**	-1.778***	-1.735***	-2.094***
	[0.259]	[0.485]	[0.275]	[0.516]	[0.156]
Bank Liq. Asset / TA	-0.621***	-0.504	0.467*	0.615	0.480**
	[0.239]	[0.449]	[0.261]	[0.488]	[0.200]
Bank Net Charge-off / TA	0.121**	0.15	0.199**	0.217	0.521***
	[0.061]	[0.120]	[0.079]	[0.152]	[0.055]
Large Bank Dummy	0.01	-0.007	0.375***	0.413***	0.393***
	[0.095]	[0.180]	[0.068]	[0.125]	[0.039]
Inv. Bank Dummy	-0.319***	-0.25	-0.252*	-0.188	-0.270***
	[0.091]	[0.174]	[0.131]	[0.248]	[0.088]
Regional Bank Dummy	0.054	0.066	0.169***	0.197*	0.104***
	[0.060]	[0.116]	[0.057]	[0.109]	[0.037]
Firm Size					0.005**
					[0.003]
Firm Cash/ TA					0.073
					[0.051]
Firm Ebitda					0.063*
					[0.036]
Firm Leverage					-0.138***
					[0.022]
Firm Sales / TA					0.011***
					[0.003]
Firm Rating A Dummy					0.072
					[0.053]
Firm Rating B Dummy					0.143***
					[0.035]
Firm Rating C Dummy					-0.090**
					[0.039]
Firm Rating D Dummy					-0.387***
					[0.062]
Constant	-0.773	-1.278	1.657**	1.529	1.360***
	[0.725]	[1.323]	[0.705]	[1.305]	[0.406]
Observations	9329	45069	9285	45010	30498
Firm Fixed Effects	Yes	Yes	Yes	Yes	No
Multi-bank firms Only	Yes	No	Yes	No	No
R-squared	0.76	0.93	0.77	0.93	0.07

Table 11: Effect of Bank Capital Surplus and Proposed Regulatory Capital ratio Change on Loan Growth: ALL BHCs.

This table reports the estimation results of cross-section equation (1) replacing equity capital with a capital surplus (shortfall) measure for all non-CCAR BHCs subject to Basel III capital rules, by type of loan (total, consumer and industrial (C&I), real estate, and consumer). Reg. K ratio change is the difference between Basel I and Basel III tier 1 capital ratios according to the proposed rules. Reg. K ratio change N and Reg. K ratio change D are the changes in the numerator and denominator of the tier 1 capital ratio between the Basel I and Basel III capital frameworks, respectively. Unemployment rate is the BHC-specific unemployment rate calculated using state-level unemployment rates weighted by BHC's state-level deposits. Robust standard errors are indicated in brackets. ***, **, and * indicate statistical significance at the 1%, 5% and 10% level, respectively.
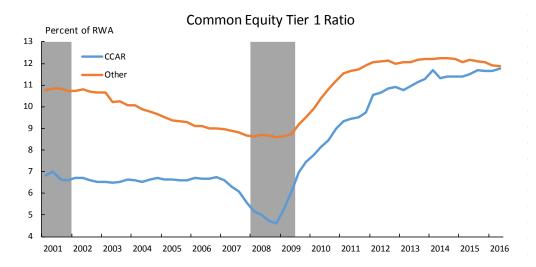
Vars	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Equity Capital surplus	0.776***	0.628***	0.931**	0.650*	0.640***	0.495**	1.287***	0.984**
	[0.193]	[0.197]	[0.373]	[0.386]	[0.209]	[0.217]	[0.448]	[0.461]
Reg. K ratio change (proposed rule)	-0.49		-0.675		-0.743**		-1.513**	
	[0.302]		[0.584]		[0.302]		[0.709]	
Reg. K ratio change N		-0.740***		-1.404***		-0.791***		-1.603**
		[0.236]		[0.489]		[0.279]		[0.669]
Reg. K ratio change D		0.05		0.028		-0.152		-0.211
		[0.115]		[0.219]		[0.121]		[0.255]
Size	0.017***	0.017***	0.022***	0.023***	0.010*	0.011**	0.029**	0.030**
	[0.004]	[0.004]	[0.008]	[0.008]	[0.005]	[0.006]	[0.012]	[0.012]
ROA	0.007*	0.008*	0.008	0.008	0.011**	0.011**	0.005	0.004
	[0.004]	[0.004]	[0.009]	[0.009]	[0.005]	[0.005]	[0.011]	[0.012]
Deposit / TA	0.084	0.074	-0.035	-0.056	-0.074	-0.065	-0.021	-0.006
	[0.055]	[0.052]	[0.186]	[0.181]	[0.115]	[0.113]	[0.169]	[0.169]
Liq. Asset / TA	-0.016	-0.031	-0.033	-0.068	-0.012	-0.038	-0.067	-0.114
	[0.035]	[0.038]	[0.065]	[0.071]	[0.040]	[0.044]	[0.089]	[0.094]
Net Charge-off / TA	-0.027**	-0.027**	-0.033*	-0.033*	-0.024**	-0.024**	-0.002	-0.001
	[0.012]	[0.012]	[0.019]	[0.018]	[0.012]	[0.012]	[0.028]	[0.029]
Unemployment rate	-0.004	-0.005*	-0.003	-0.003	-0.004	-0.004	-0.01	-0.01
	[0.003]	[0.003]	[0.005]	[0.005]	[0.003]	[0.003]	[0.007]	[0.007]
Constant	-0.208**	-0.207**	-0.152	-0.147	0.014	0.012	-0.265	-0.275
	[0.087]	[0.084]	[0.228]	[0.222]	[0.135]	[0.132]	[0.226]	[0.226]
Observations	814	814	813	813	813	813	809	809
R-squared	0.11	0.12	0.05	0.06	0.09	0.09	0.04	0.04

Table 12: Effect of Bank Capital Surplus and Final Regulatory Capital ratio Change on Loan Growth: ALL BHCs.

This table reports the estimation results of cross-section equation (1) replacing equity capital with a capital surplus (shortfall) measure for all non-CCAR BHCs subject to Basel III capital rules, by type of loan (total, consumer and industrial (C&I), real estate, and consumer). Reg. K ratio change is the difference between Basel I and Basel III tier 1 capital ratios according to the final rules. Reg. K ratio change N and Reg. K ratio change D are the changes in the numerator and denominator of the tier 1 capital ratio between the Basel I and Basel III capital frameworks, respectively. Unemployment rate is the BHC-specific unemployment rate calculated using state-level unemployment rates weighted by BHC's state-level deposits. Robust standard errors are indicated in brackets. ***, **, and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

ALL BANKS	Total Loans		C&I Loans		Real Estate Loans		Consumer Loans	
Vars	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Equity Capital surplus	0.662***	0.640***	0.764**	0.734**	0.800***	0.788***	0.443	0.362
	[0.165]	[0.173]	[0.339]	[0.335]	[0.195]	[0.206]	[0.494]	[0.506]
Reg. K ratio change (final rule)	0.569		-0.26		0.727*		-0.088	
	[0.354]		[0.628]		[0.401]		[0.958]	
Reg. K ratio change N		0.504		0.1		0.489		0.77
		[0.390]		[0.659]		[0.448]		[1.021]
Reg. K ratio change D		0.246		-0.434		0.481**		-1.094*
		[0.172]		[0.365]		[0.200]		[0.560]
Size	0.018***	0.018***	0.030***	0.031***	0.011**	0.010*	0.024*	0.028**
	[0.005]	[0.005]	[0.008]	[0.008]	[0.005]	[0.005]	[0.014]	[0.014]
ROA	0.013***	0.013***	0.010**	0.011**	0.011*	0.010*	0.024**	0.026**
	[0.005]	[0.005]	[0.005]	[0.005]	[0.006]	[0.006]	[0.012]	[0.012]
Deposit / TA	0.099	0.097	0.116	0.119	0.08	0.075	-0.036	-0.002
	[0.080]	[0.080]	[0.096]	[0.094]	[0.080]	[0.081]	[0.184]	[0.188]
Liq. Asset / TA	-0.090***	-0.099***	-0.155**	-0.139**	-0.118***	-0.135***	-0.1	-0.066
	[0.032]	[0.032]	[0.061]	[0.061]	[0.038]	[0.038]	[0.087]	[0.087]
Net Charge-off / TA	-0.046***	-0.046***	-0.043**	-0.043**	-0.051***	-0.052***	-0.042**	-0.041**
	[0.009]	[0.009]	[0.021]	[0.021]	[0.010]	[0.010]	[0.019]	[0.019]
Unemployment rate	0.001	0.001	0.010**	0.009*	-0.002	-0.001	0.009	0.006
	[0.003]	[0.003]	[0.005]	[0.005]	[0.003]	[0.003]	[0.008]	[0.008]
Constant	-0.216**	-0.202*	-0.434***	-0.464***	-0.076	-0.046	-0.329	-0.435
	[0.105]	[0.106]	[0.154]	[0.153]	[0.115]	[0.117]	[0.284]	[0.287]
Observations	812	812	811	811	811	811	804	804
R-squared	0.11	0.11	0.05	0.05	0.09	0.1	0.02	0.03

Figure 1

Regulatory Capital Ratios for CCAR and Non-CCAR BHCs

Common Equity Tier 1 Ratio

Note: Prior to 2014:Q1, the numerator of the common equity tier 1 ratio is tier 1 common capital. Beginning in 2014:Q1 for advanced approaches BHCs and in 2015:Q1 for all other BHCs, the numerator is common equity tier 1 capital. Advanced approach BHCs are BHCs with >$250B in total assets as of 2015:Q4.
Source: FR Y-9C.

Figure 2

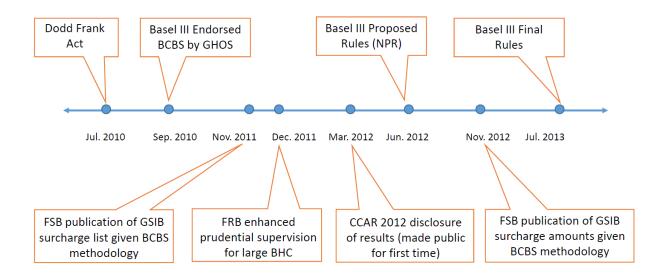## U.S. Post-Crisis Regulatory Reform Timeline

Figure 3

Basel I and Basel III Capital Ratios
Mean Tier 1 Capital Ratio, Mar. 2012

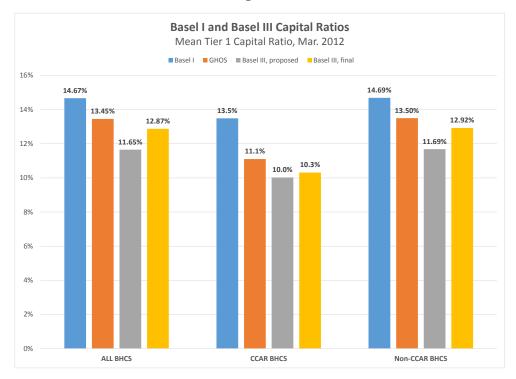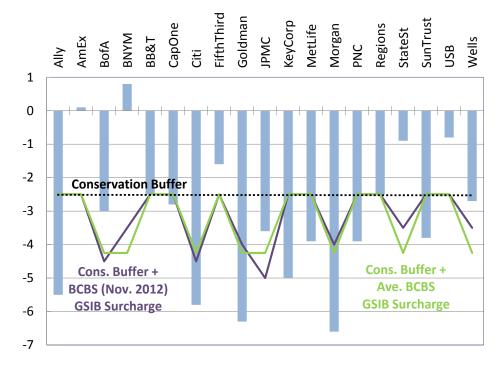■ Basel I ■ GHOS ■ Basel III, proposed ■ Basel III, final

Figure 4

Decline in Tier One Common Equity Ratio in CCAR 2012 before Capital Distributions

Note: Bank-specific stress tests results are taken from the 2012 CCAR public disclosure document available at http://www.federalreserve.gov/newsevents/press/bcreg/bcreg20120313a1.pdf.