Off-Balance-Sheet Securitization, Bank Lending, and Corporate Innovation*

Yiwei Dou† and Zhaoxia Xu‡

Abstract

We investigate how corporate innovation is influenced by banks' off-balance-sheet securitization. Exploiting a recent mandate that removes the off-balance-sheet status of some securitized assets, we find a reduction in innovation for firms borrowing from affected banks. The reduction is concentrated among firms whose banks experience more downward pressure on regulatory capital ratios and greater market discipline, and firms more dependent on external finance. Affected banks raise loan spreads and cut loan amounts after the mandate. Various robustness analyses show that off-balance-sheet treatment of securitization has a real impact on firm innovation through bank lending.

Key Words: Financial Innovation, Off-Balance-Sheet, Securitization, Bank Lending, Corporate Innovation, R&D.

JEL Classification: G31, G32, M41, O30, Ol6.

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†Department of Accounting, New York University, 44 West Fourth Street, New York, NY, 10012. Email: ydou@stern.nyu.edu. Phone: (212) 998-0025. Fax: (212) 995-4230.

‡School of Banking and Finance, UNSW Business School, Room 337, Business School Building, UNSW, Sydney, NSW 2052, Australia. Email: zhaoxia.xu@unsw.edu.au. Phone: +61 (2) 9385-6013.

1 Introduction

One of the most influential financial innovations over past three decades is securitization (Lerner and Tufano, 2011; Obay, 2013), a process in which banks sell financial assets to a legally separate special purpose entity (SPE) that issues asset-backed securities (ABSs) to broad investor classes.[1] This process, by design under the accounting and regulatory rules, allows a bank to keep most securitized assets off the balance sheet. Much of the existing work focuses on the consequences of the originate-to-distribute model induced by securitization, such as reduced incentives to monitor borrowers.[2] Relatively less attention has been devoted to the off-balance-sheet status of securitization and its implications to the real economy. In this paper, we investigate how the off-balance-sheet treatment of banks' securitization (hereafter, "off-balance-sheet treatment") influences their borrowers' technological innovation, a key driver of economic growth (King and Levine, 1993).

A priori, neither the direction nor the magnitude of the impact of off-balance-sheet treatment of securitization on borrowers' innovation is clear. On the one hand, the expanded lending capacity from the off-balance-sheet treatment can translate into more and cheaper commercial lending (Calomiris and Mason, 2004).[3] This increased credit supply

[1] According to the flow of funds accounts of the United States, $3.5 trillion of financial assets were securitized as of 2006:Q4 (Table L.126), in comparison to $6.1 trillion of total loans held on balance sheets of commercial banks (Table L.109).

[2] With the originate-to-distribute model, banks originate loans and then sell them securitization vehicles. Under this mechanism, originating banks have limited exposure to the risk of sold loans and hence have lower incentives to monitor borrowers (Keys et al., 2010; Wang and Xia, 2014).

[3] Suppose a bank holds $100 million of loan assets funded by $90 million of deposits and $10 million of equity (to maintain a target capital ratio of 10%). By securitizing $20 million of existing loans, the bank effectively refinances these loans using $20 million of ABSs, with $20 million of cash from deposits freed up for new lending. More importantly, off-balance-sheet treatment allows the bank to remove securitized loan assets and ABS liabilities from both sides of its balance sheet, leaving the capital ratio intact. Without such treatment, the $20 million of deposits cannot be used for loans and have to be paid off to meet the target ratio. Figure 1 illustrates the three aforementioned cases.

may alleviate borrowers' financial constraints and promote their innovation (Kerr and Nanda, 2015). Loans may be used to finance innovation projects directly (Chava et al., 2016; Mann, 2016) and/or indirectly, whereby firms finance traditional investments with bank loans and then divert internal resources to fund the innovation projects (Amore et al., 2013).

On the other hand, prior research finds that bank credit exerts no or even negative effects on borrowers' research and development expenditures (R&D) both in the U.S. (Bhagat and Welch, 1995) and in international settings (Brown et al., 2013; Hsu et al., 2014). Because of innovation projects' unstable internal cash flows to service debt, right-skewed returns that cannot be claimed by creditors, and given its limited collateral value, banks may impose stringent loan terms and exhibit little tolerance during renegotiation following covenant violation or project failure. Consequently, increased commercial credit arising from the off-balance-sheet treatment of securitization may not help or can even discourage innovation (Beck and Levine, 2002; Hall and Lerner, 2010). Thus, how this treatment of bank securitization of loans influences borrowers' innovation is ultimately an empirical question.

We answer this question by exploiting a recent regulation that removes the off-balance-sheet status for some securitized assets. The Financial Accounting Standards Board (FASB) tightened accounting and consolidation rules for securitization by issuing the Statement of Financial Accounting Standards (SFAS) Nos. 166 and 167 (FASB, 2009a,b), effective at the beginning of 2010. As a result, banks were forced to consolidate $765 billion of securitized assets, about 80% of those assets held in credit card master trusts, 10% held

in asset-backed commercial paper (ABCP) conduits, and 10% held in other securitization entities (Dou et al., 2017). Bank regulators shortly thereafter decided to include the consolidated assets and associated loan loss reserves in those entities for regulatory capital calculations (Federal Reserve Board, 2010).[4] We estimate that the combined new rules (hereafter, "the new regulation" or "the regulation" for brevity) on average reduced newly consolidating banks' tier 1 leverage capital ratio by about one percentage point, which is considerable in comparison to Berger et al. (2008, p.137)'s estimate that banks on average manage that ratio upwards by 46 basis points.

Examining the impacts of this new regulation is particularly advantageous for answering our research question. First, this regulation by taking away the off-balance-sheet status of some securitized assets, but not the originate-to-distribute model enables us to isolate the impacts of the former. In contrast, it is generally difficult to separate this effect prior to this regulatory change as the "favorable" treatment often goes hand-in-hand with the originate-to-distribute model (Wang and Xia, 2014). Second, we are interested in how the off-balance-sheet treatment influences borrowers' innovation by altering banks' corporate lending. In comparison to home mortgages and consumer loans, commercial loans are more difficult to securitize due to their heterogeneity.[5] As a result, any effect of this regulation on commercial lending likely operates through heightened capital requirements and/or increased funding costs. Third, the new regulation affects primarily

[4]Regulators included consolidated securitized assets and associated loan loss reserves during leverage ratio calculations starting in 2010:Q1 and risk-based capital ratio calculations with an optional two-quarter delay and two-quarter phase-in period. Regulators also eliminated the exclusion of on-balance-sheet ABCP conduits in risk-based capital ratio calculations (Federal Reserve Board, 2010; Acharya and Ryan, 2016). See Section 2 for institutional details.

[5]Loutskina (2011) estimates that by 2007:Q4, 60% of home mortgages, 28% of consumer loans, and 3% of commercial and industrial loans are securitized.

banks that securitize credit card loans, but not those securitizing other financial assets (Tian and Zhang, 2016). This allows us to compare changes around the regulation in the innovation of firms that borrow from consolidating banks (hereafter, "affected banks") versus otherwise similar matched firms that borrow from non-consolidating securitizing banks (hereafter, "unaffected" banks).[6]

Although the selection of lenders and their consolidation of securitized assets likely reflect diverse borrower attributes and lender securitization activities, a serious effort is made to address this issue through a propensity score matching method. Specifically, for each treatment firm that borrows from affected banks, we select a matched firm that borrows from unaffected banks, but has the closest firm characteristics and bank's total securitized assets. This approach weakens the link between a firm's treatment status and other covariates, effectively restricting attention to a select group of matched treatment and control firms, with evidence of statistically insignificant differences in their characteristics and banks' total securitized assets.

We employ a difference-in-differences approach to the matched sample of treatment and control firms. The approach removes any permanent differences between the treatment and control firms and any common trend affecting both groups. The sample period is from 2007 to 2013, including three years before (the pre-period) and four years since (the post-period) adoption of the regulation. In the primary analysis, we find a significant

[6]Although unaffected banks engage more in the securitization of assets other than credit cards, they do not appear to suffer less from liquidity shocks during the recent financial crisis relative to affected banks. This is because non-credit card securitization (mostly home mortgages) declines no less than credit card securitization during and after the crisis. Purnanandam (2011) demonstrates that the financial crisis significantly increased loan charge-offs and deteriorated return on assets (ROA) for banks that relied on the originate-to-distribute model. We observe no significantly different change in bank ROA and loan charge-offs around the regulation between the two types of banks that issue loans to our sample firms.

decrease in R&D and patent production for treatment firms following the new regulation, in comparison to control firms. The ratio of R&D to total assets declines about 16% relative to the mean and the number of patents (citations per patent) drops by about 14%-15% (3%-5%), both of which are economically significant. Further, the decrease in innovation holds more strongly for firms whose lenders experience a larger downward impact on tier 1 capital ratios and greater market discipline as proxied by higher uninsured deposits, and for firms in more external finance dependent industries.

We assess to what extent our findings are attributable to the regulation as opposed to other economic forces, such as pre-existing trends or differential exposure to the financial crisis. First, we examine the dynamic effects of this regulation by tracing the timing of the innovation reduction. We find that the reduction does not appear prior to the regulation, manifests itself after the implementation, and becomes stronger in later years, suggesting that pre-existing divergent trends in firm innovation are unlikely explanations for our the findings. Second, we conduct falsification tests assuming the year preceding the crisis (i.e., 2006) as a pseudo effective year of the regulation. We do not observe significantly different changes in innovation between the treatment and control firms around the pseudo effective year. Thus, it is unlikely that firms' differential exposure to the financial crisis influences our results.

To shed light on the mechanisms that underlie the reduction in firm innovation, we investigate changes in contractual terms of the loans extended to treatment and control firms. Theoretical and empirical studies demonstrate that an incumbent bank's private information about a borrower's creditworthiness often prevents the borrower from switching

to new funding sources as it is pegged as a lemon by outside capital providers (Rajan, 1992; Santos and Winton, 2008; Hale and Santos, 2009; Bushman et al., 2017). This information monopoly problem is particularly severe for firms with substantial R&D expenditures (Houston and James, 1996). If the regulation that removes the off-balance-sheet status of securitization hinders firm innovation through a decrease in the credit supply, we expect that loans extended by affected banks experience an increase in spreads and a decrease in amounts, in comparison to loans of unaffected banks following the regulation. The results confirm this expectation. To further ease any concerns about the differences in affected and unaffected banks, we match banks based on their characteristics. The results are robust to using a sample of matched banks, in which bank characteristics are statistically indistinguishable. Collectively, these findings support the notion that a bank's ability to obtain off-balance-sheet treatment of its securitized loans affects borrowers' innovation activities by lowering their borrowing costs and increasing the loan amounts.

In the final set of analyses, we consider five potential confounding events that may have coincided with the implementation of the new regulation. Following the extant literature, we measure the impacts of plunges in real estate markets, the third installment of the Basel Accords (Basel III), and the Dodd-Frank Wall Street Reform and Consumer Protection Act (Dodd-Frank Act). We also identify banks that are subject to stress tests or participate in the Troubled Asset Relief Program (TARP). Our results for innovation and loan terms are resilient to accounting for the impacts of the five events, suggesting that those events unlikely drive our findings.

This paper contributes to the literature in three ways. First, finance scholars have

been interested in understanding how the development of conventional financial systems shapes innovation. Our study extends the inquiry to securitizations that are not held on banks' balance sheets, an important yet largely under-investigated financial sector in the innovation literature. Second, by exploiting a recent accounting and regulatory change, we are able to isolate the implications of off-balance-sheet treatment, thus complementing the securitization literature that mostly focuses on the economic-risk-transfer aspect. Third, we document how SFAS 166/167 and the associated regulatory decisions for banks influence borrowing firms' real economic activities. This evidence complements concurrent research that confines the investigation of the regulation's impacts to banks (Tian and Zhang, 2016; Bonsall et al., 2017; Dou, 2017; Dou et al., 2017).

Finally, our evidence does not imply that regulators should grant the off-balance-sheet status to more bank assets in order to promote innovation and social welfare. Numerous studies show that securitization's off-balance-sheet status makes financial systems more vulnerable by creating incentives for regulatory arbitrage and excess risk-taking (Loutskina, 2011; Acharya et al., 2013). Our results speak to the other side of the trade-off: although the off-balance-sheet treatment may induce activities jeopardizing financial stability, policies aimed at eliminating the treatment could have unintended consequences on the economy by inhibiting innovation activities. This finding should be of interest to policymakers that are currently deliberating how to appropriately regulate securitization markets to encourage healthy economic risk-taking while maintaining financial stability (Federal Reserve Board, 2009; Murphy, 2013; IMF, 2014; Financial Stability Board, 2015).

2 Background and Related Research

2.1 Institutional Background

Securitization transforms financial assets to securities that are backed by cash flows generated from the assets and appeal to a broad range of investor classes (e.g., money market funds). The process typically involves the transfer of financial assets to a legally separate securitization entity (e.g., SPE), which then designs and sells the securities. Banks either securitize their own assets with provisions of implicit/explicit recourse or sponsor ABCP conduits for other institutions by providing administrative services and/or credit/liquidity enhancement (Higgins and Mason, 2004; Bens and Monahan, 2008; Cetorelli and Peristiani, 2012).[7]

Prior to the issuance of SFAS Nos. 166 and 167, many securitization entities (e.g., credit card master trusts) were devised as qualifying special purpose entities (QSPEs), which were not consolidated with the financial statements of securitizing banks under SFAS No. 140 (paragraph 46). Per SFAS No. 140, assets transferred to QSPEs and liabilities incurred in the issuance of ABS can then be removed from banks' balance sheets under sale accounting. Non-QSPEs, such as ABCP conduits, were considered variable interest entities (VIEs), which were consolidated by their primary beneficiaries based on a quantitative model under FIN 46 (R). The primary beneficiary was identified as the organization that absorbed the majority of the VIE's expected losses. Although sponsor

[7]The recourse and enhancement suggest that some of the risks of securitized assets are still borne by banks. See Niu and Richardson (2006), Landsman et al. (2008), Chen et al. (2008), Cheng et al. (2011), Barth et al. (2012), and Dou et al. (2014) for empirical evidence.

banks usually qualified as the primary beneficiary, they often altered deal structures to circumvent FIN 46 (R) rules (Bens and Monahan, 2008). Overall, under previous accounting pronouncements, most securitization entities remain off-balance sheet.

Off-balance-sheet securitized assets were subject to no regulatory capital requirements. Moreover, regulators enacted an ABCP exclusion rule that requires only 10% of normal risk-based capital charges for on-balance-sheet conduit assets that are covered by eligible liquidity guarantees from sponsor banks (Federal Reserve Board, 2004). Acharya et al. (2013) demonstrate that such favorable treatment creates motives for banks to set up conduits and structure guarantees in certain ways so that regulatory capital arbitrage is achieved.

The off-balance-sheet treatment was criticized as banks incurred considerable losses from their securitizations during the recent financial crisis (FASB, 2009b; Acharya et al., 2013). Effective at the beginning of 2010, the new accounting rules tighten the scope of off-balance-sheet treatment for securitization. In particular, SFAS No. 166 eliminates the QSPE concept in SFAS No. 140, subjecting these entities to consolidation guidance of FIN 46 (R) (Deloitte, 2014). SFAS No. 167 amends FIN 46 (R) by adopting a qualitative rather than quantitative model to identify the primary beneficiary of a VIE. The primary beneficiary is defined as the interest holder that has both power over the entity and significant exposure to the losses or benefits from the entity. The new approach diminishes opportunities for restructuring arrangements to avoid consolidation (FASB, 2009b). Because of the revolving nature of credit card loans, banks that securitize these loans are deemed primary beneficiaries and have to consolidate them under SFAS No. 167 (Deloitte,

2014; Tian and Zhang, 2016).[8] Previous restructuring arrangements by sponsor banks to circumvent FIN 46 (R) no longer work under SFAS No. 167, and they need to consolidate their ABCP conduits. Collectively, the new standards bring previously off-balance-sheet securitized assets worth 5.46% of banks' total assets onto their financial statements.[9]

Shortly after the implementation of the new accounting standards in January 2010, bank regulators issued a final rule that includes consolidated assets in regulatory capital calculations. Consolidating banks are required to recognize the loss reserves for loans of consolidated securitization entities, which reduces the numerator of capital ratios (i.e., tier 1 capital), and to include net assets of the entities in total assets, which increases the denominator (i.e., total or risk-weighted assets). Together, the consolidation imposes sizable downward pressure on the regulatory capital ratios of consolidating banks. For example, Capital One expected a reduction in the Tier 1 leverage capital ratio from 10.28% to 5.84% from the consolidation (2009 10-K). Although many banking institutions express concern about the pressure and consequent reductions in credit availability (American Bankers Association, 2009), regulators grant only an optional two-quarter delay and optional phase-in over subsequent two quarters for risk-based capital ratios (but not for leverage ratios). The ABCP exclusion is also eliminated.

Extant banking research demonstrates that banks actively manage their capital ratios around target levels in excess of regulatory minimums, and shocks to the ratios result in adjustments toward the target by altering assets and liabilities, but not equity (Peek

[8]The vast majority of residential mortgage securitizations and collateralized loan obligations (CLOs) remain unconsolidated with securitizing banks' balance sheets. Instead, they are consolidated by third-party servicers and CLO asset managers, respectively (Deloitte, 2014; Bonsall et al., 2017).

[9]We estimate the percentage using the banks of our sample firms. See Section 3 for our sample construction process.

and Rosengren, 1997; Berger et al., 2008; Kashyap et al., 2010; Adrian and Shin, 2011). Thus, heightened capital requirements can lead to a contraction of lending to lower the denominator of capital ratios and an increase in interest rates to increase the numerator of capital ratios through retained earnings. Both responses facilitate convergence to target ratios.[10] In addition to the regulatory capital effect, consolidation potentially increases market discipline over banks (e.g., increases the cost of capital) to the extent that market participants view on-balance-sheet items as riskier than off-balance-sheet ones (Barth et al., 2012; Callahan et al., 2012; Bonsall et al., 2017). The increased market discipline can pressure banks to lend less and charge higher interest (Bushman, 2014).

2.2 Related Research

Our study is related to three strands of literature. First, the emerging literature on finance and innovation shows relationships between innovation outputs and an assortment of aspects of financial markets, such as the development of equity and debt markets (Benfratello et al., 2008; Brown et al., 2009, 2013; Hsu et al., 2014; Nanda and Nicholas, 2014; Moshirian et al., 2015), venture capital and private equity (Kortum and Lerner, 2000; Lerner et al., 2011; Chemmanur et al., 2014; Tian and Wang, 2014), public listing (Bernstein, 2015; Acharya and Xu, 2017), stock liquidity (Fang et al., 2014), market sentiment (Dang and Xu, 2017), analyst coverage (He and Tian, 2013), institutional ownership (Aghion et al., 2013; Luong et al., 2017), hedge fund activism (Brav et al.,

[10]In a world with perfect capital markets for banks (i.e., where the Modigliani-Miller theory applies for banks), we should not expect those changes in bank operations since banks can issue new equity to meet heightened capital requirements. However, a great deal of the banking literature demonstrates that it is prohibitively costly for banks to raise new capital immediately due to severe information asymmetry problems. See Kashyap et al. (2010) for a comprehensive review of the theoretical and empirical banking research on the impacts of capital requirements on bank operations.

2017), creditor rights (Acharya and Subramanian, 2009; Gu et al., 2016; Mann, 2016), and bank deregulation (Amore et al., 2013; Chava et al., 2013; Cornaggia et al., 2015; Hombert and Matray, 2016).

While the aforementioned aspects influence innovation through various channels, altering the financial constraints of innovative firms is one common mechanism that applies to not only private businesses or startups, but also public firms (Amore et al., 2013; Kerr and Nanda, 2015). We add to this literature by examining how off-balance-sheet securitization, a large and understudied financial sector, shapes the financing of innovation. We find evidence consistent with the view that the off-balance-sheet feature of securitization affects innovation by lowering borrowing costs and increasing loan amounts of innovative firms.

Second, the recent financial crisis ignited enormous interest of policy makers, regulators, investors, academics, and the general public in understanding how securitization affects financial stability and economic growth. Most of extant research concentrates on the risk-transfer aspect and its consequences on monitoring borrowers, funding costs of banks, and security design choices (Benmelech and Dlugosz, 2009; Berndt and Gupta, 2009; Downing et al., 2009; Drucker and Puri, 2009; Mian and Sufi, 2009; Keys et al., 2010; Ayotte and Gaon, 2011; Purnanandam, 2011; Benmelech et al., 2012; Gande and Saunders, 2012; Jiang et al., 2014a,b; Lemmon et al., 2014; Nadauld and Weisbach, 2012; Wang and Xia, 2014; Begley and Purnanandam, 2017).

In contrast, the off-balance-sheet treatment that enables banks to circumvent capital requirements receives limited attention. Calomiris and Mason (2004) show that regulatory

arbitrage is an important motive for banks engaging in credit card securitization and the avoidance of capital requirements appears more for efficient contracting as opposed to safety net abuse. Acharya et al. (2013) study ABCP markets and conclude that the off-balance-sheet feature incentivizes banks, especially those with less capital, to sponsor ABCP conduits and such securitization does not transfer risk as sponsor banks absorbed all losses in the early phase of the financial crisis. While these two studies focus on banks, we extend this line of inquiry to the innovative aspect of borrowing firms, a vital piece for long-run economic growth (Kogan et al., 2016).

The third line of research provides evidence that SFAS Nos. 166 and 167 and associated bank regulatory decisions affect banks' credit card lending and securitization (Tian and Zhang, 2016), mortgage approval and sale rates (Dou et al., 2017), mortgage servicing (Bonsall et al., 2017), and small business lending (Dou, 2017). None of these studies, however, look at borrowers of affected banks, missing the opportunity to document direct effects of this regulation on real economic activities. Using detailed data on lending relationships, we are able to identify firms that borrow from affected banks and examine how these firms' innovation is influenced by the new regulation. The examination of those firms provides direct evidence on how regulating off-balance-sheet treatment of banks' securitization affects firms' investment in innovation. In addition, none of prior studies explore impacts of the regulation on specific loan terms, which we address in this paper. Our results of heightened loan spreads and reduced loan amounts, along with their findings of reduced lending in credit cards, mortgages, and small business loans provide collective support for the notion that removing off-balance-sheet treatment of securitization curtails

overall credit supply.

3 Data and Measures

3.1 Data

We collect patent, citation, and technology class data from the United States Patent and Trademark Office (USPTO). We download entire patent documents for the 2007-2016 period and extract information about assignee names, patent numbers, application dates, grant dates, cited patents, and citing patents. The patent data are then matched with the financial data of firms from Compustat by company and assignee names. We manually check the names to ensure the accuracy of the match. In cases where the names are not exactly identical, we conduct Internet searches and include the observation only if we are confident about the match. We use NBER patent data for 1976-2006 and Kogan et al.'s (2016) patent data for 1926-2010 to help with the matching and validation of our data. Following the innovation literature, the patent and citation counts are set to zero when no information is available. Including firm-year observations with no patents alleviates the sample selection concern. Firms in financial and utilities industries (SIC code 6000-6999 and 4900-4999) are excluded. We require firms to have complete data on total assets and a positive value on sales. Firm-years with total assets less than $1 million are excluded. The ratios are winsorized at 1% and 99% to avoid effects of outliers.

We identify firms' lenders using the loan-level data from Thomson Reuter's DealScan database. DealScan provides information on the borrower, the lender (or lenders for syndicated loans), and the terms of a loan facility. In the case of syndicated loans with

multiple lenders, we consider the lead agent as the lender of the borrowing firm.[11] We match borrowers with their financial data using Chava and Roberts (2008) DealScan-Compustat link table. We link lenders to the financial information of their parent bank holding companies (BHCs) in FR Y-9C Reports if a lender belongs to a BHC, and to financial data in Call Reports if a lender is a standalone commercial bank. We collect consolidation of securitization information from Schedule H-CV of FR Y-9C Reports and Schedule R-CV of Call Reports.

3.2 Samples

Since the new regulation took effect in 2010, we focus on the sample period from 2007 to 2013. To understand how banks' consolidation of previously off-balance-sheet securitization entities affects firm innovation through the bank lending channel, we create two samples. The first sample is constructed at the firm-bank-year level initially and then aggregated to the firm-year level. Specifically, for each loan initiation, we assume the firm-bank relationship continues throughout the entire lifecycle of the loan, and assign bank characteristics to firm observations accordingly, following Chakraborty et al. (2016). If a firm borrows from multiple lenders, all bank characteristics are averaged to the firm-

[11] We identify the lead agent following a procedure similar to Chakraborty et al. (2016). The lender with the highest rank in the following ranking hierarchy is considered as the lead agent: 1) lender is denoted as "Admin agent," 2) lender is denoted as "Lead bank," 3) lender is denoted as "Lead arranger," 4) lender is denoted as "Mandated lead arranger," 5) lender is denoted as "Mandated arranger," 6) lender is denoted as either "Arranger" or "Agent" and has a "yes" for the lead arranger credit and the agent credit, 7) lender is denoted as either "Arranger" or "Agent" and has a "yes" for the lead arranger credit and a "no" for the agent credit, 8) lender is denoted as either "Arranger" or "Agent" and has a "no" for the lead arranger credit, 9) lender has a "yes" for the lead arranger credit but has a role other than those previously listed ("Participant" and "Secondary investor" are also excluded), 10) lender has a "no" for the lead arranger credit but has a role other than those previously listed ("Participant" and "Secondary investor" are also excluded), and 11) lender is denoted as a "Participant" or "Secondary investor."

year level weighted by the prevailing loan amounts borrowed from each bank.[12] In our sample, 11.53% of firms borrow from multiple banks. We include only firms that borrow at least one loan before and after the new regulation. In our treatment group, firms borrow loans from the same banks that consolidate off-balance-sheet securitization entities under the new regulation; firms in the control group borrow from unaffected banks.

To ease the concern that firms in the treatment and control groups may be incomparable, we select these firms using the propensity score matching method. We estimate the propensity score from a logit regression with the treatment dummy as the dependent variable and the mean values of $ln(Sales)$, M/B, PPE, CF, $S.Growth$, $Leverage$, $Cash$, change in R&D, change in other investments (i.e., capital and acquisition expenditures), and banks' total securitized assets over the period before the regulation (2007-2009) as independent variables.[13] The variable definitions are in the Appendix. We use the propensity scores to conduct the nearest neighbor matching without replacement. Treatment and control firms are required to be in the same 3-digit SIC code industries. The final matched sample contains 173 treatment firms and an equal number of control firms, representing 2,422 firm-year observations in total. We use this sample to investigate the effects of the new regulation on firm innovation.

Panel A in Table 1 presents the differences in firm characteristics for the unmatched raw sample and the matched sample. After matching, the firm characteristics are indistin-

[12]For example, Firm A borrowed $5 million from Bank A in 2007, a loan with a five-year maturity. Firm A then borrowed another $10 million from Bank B in 2009, a loan with a three-year maturity. We first compile a sample of eight firm-bank-year observations and then collapse it to a sample of five firm-year observations using Bank A's characteristics in 2007-2008 and the weighted averages of Bank A's and B's characteristics in 2009-2011 with the weight of 1:2.

[13]Since investments can be lumpy, we include the change in R&D and the change in other investments to ensure the treatment and control firms have similar investment patterns before the regulation.

guishable between the treatment and control groups, except for $ln(Sales)$. To disqualify the possibility that differences in these characteristics rather than the regulation influence innovation activities across the treatment and control firms, we control for these variables throughout our analyses. The summary statistics of these variables of the pooled matched sample are reported in Panel B. An average firm has a market-to-book ratio of 1.66, files 35 patents, and borrows from banks with securitized assets worth 17.62% of bank assets. Table 2 presents the industry distribution of sample firms, in which the industry classification is based on the 2-digit SIC codes.

The second sample, constructed at the loan-level, is used to examine the impact of consolidating securitization entities on bank lending. We collect all loans and their contractual terms for treatment and control firms. This sample allows us to test for potential changes in loan terms around the implementation of the regulation. In the bottom two rows of Panel B in Table 1, we present loan spreads and facility amounts of the 1,509 loans in the sample. An average loan has the spread of 176 ($= e^{5.17}$) basis points.

3.3 Innovation Measures

We use R&D spending, defined as R&D expense scaled by lagged total assets, to capture innovation input and patent-based metrics to measure innovation output (Hall et al., 2001, 2005). The first measure of innovation output is the number of patent applications filed by a firm in a given year. The patent application year is used to construct the measure since the application year is closer to the time of the actual innovation (Griliches, 1990). While our sample period ends in 2013, we collect patent data up to 2016 because the average time lag between the application date and grant date of the patent is two to three years

(Hall et al., 2001). The second measure is the citation count per patent in subsequent years. The number of citations measures the importance of a patent. To correct for the time trend in citations, we scale the raw patent citation count by the average citation count of all patents applied in the same year and technology class following Hall et al. (2001, 2005). The technology classes are based on U.S. Patent Classification System. This measure indicates the relative citation counts compared to peer patents filed in the same year and technology class.

4 Empirical Analysis

4.1 Firm Innovation

We employ the difference-in-differences method to a matched sample of treatment and control firms. The empirical model we estimate is as follows:

$$Y_{ikt} = \alpha + \beta_1 Post_t \times Treat_i + \beta_2 X_{it-1} + \beta_3 Z_{it-1} + \eta_i + \gamma_{kt} + \varepsilon_{ikt}, \quad (1)$$

where i indexes firm, k indexes industry, and t indexes time. The dependent variable Y is the proxy of firms' innovation activities. We use three innovation measures: the R&D spending of firm i in year t ($R\&D$), the natural logarithm of one plus the number of patents produced by firm i in year $t+1$ to $t+2$ ($Patent$), and the natural logarithm of one plus the number of citations per patent by firm i in year $t+1$ to $t+2$ ($Citations$). $Treat$ is an indicator variable that equals one if the firm borrows from a bank that consolidates securitization entities under the new regulation, and zero otherwise. $Post$ is equal to one for the post-regulation period and zero otherwise. The vector X contains firm characteristics including $ln(Sales)$, M/B, CF, PPE, $S.Growth$, $Leverage$, and

$Cash$.[14] The vector Z is a set of bank characteristics including securitized assets, bank size, capital ratios, bank ROA, charge-offs and C&I loans, aggregated to the firm-year level as discussed above. We include them to account for differences between affected and unaffected banks.

Firm fixed effects, η_i, are included to control for time-invariant differences between the treatment and control firms. Firms in the same industry may experience common demand and technology shocks. To control for the possibility of time-varying industry shocks, we include industry-year fixed effects, γ_{kt}, at the 3-digit SIC industry level. Standard errors are clustered at the industry level.

We estimate equation (1) with and without bank characteristics as controls. The variable of interest is $Post \times Treat$. Table 3 shows that the innovation activities of firms are negatively affected by their banks' consolidation of securitization entities. The negative estimates of β_1 indicate that firms borrowing from banks which consolidate previously off-balance-sheet securitized assets spend less on R&D, produce lower quantity and quality of patents after the new regulation. The deterioration of all three is also economically significant. The R&D of the treatment firms decreases 16% ($= -0.2815/1.76$) relative to the mean and the number of patents (citations per patent) drops from 14% to 15% (3% to 5%).[15] We also find that M/B and lenders' securitized assets are positively associated with R&D.

[14] We do not include $\Delta R\&D$ and $\Delta Investment$ in the analyses as $R\&D$ is a dependent variable. Nevertheless, our inference is unaffected by controlling for these two variables.

[15] Lemmon et al. (2014) report that by 2009, 126 nonfinancial firms use securitization as a form of financing. We find that 24 of them are included in our sample and removing those firms does not alter our inferences.

4.2 Dynamics of Innovation

The implementation of the new regulation in 2010 represents a shock to treatment firms' financing of their innovation activities. We estimate the impact on their innovation using a difference-in-differences approach. A concern may arise that the results simply capture pre-existing divergent trends in innovation and have nothing to do with the regulation. Another concern may be a bank's consolidation of securitization entities might be related to changes in innovation and risk-taking by borrowing firms before the regulation (i.e., reverse causality). To explore these possibilities, we follow Bertrand and Mullainathan (2003) to investigate the dynamics of innovation surrounding the new regulation. If these alternative explanations are true, we should observe declines in innovation prior to adoption of the new regulation.

We replace $Post$ in equation (1) with four indicator variables associated with the years surrounding the consolidation year: Pre, $Post^0$, $Post^1$, and $Post^{2+}$. Pre is an indicator variable that equals one for one year before the consolidation event (i.e., year 2009). $Post^0$, $Post^1$, and $Post^{2+}$ are indicator variables that equal one for year 2010 (the adoption year), year 2011, and years 2012 through 2013, respectively. The variable of interest is $Pre \times Treat$, which indicates whether there is any relation between firms' innovation and banks' consolidation of securitization entities before the new regulation. We are also interested in the coefficients on interactions between $Treat$ and other indicators, which tell the timing of the reduction in innovation.

In Table 4, we report the results when we control for all variables in the baseline model of equation (1). The coefficients on $Pre \times Treat$ are insignificant in all specifications,

indicating no difference in innovation prior to the new regulation. Thus, there is no evidence for pre-existing divergent trends or reverse causality. For $R\&D$ ($Patent$ and $Citations$), we find significant and negative coefficients on $Post^{1} \times Treat$ and $Post^{2+} \times Treat$ ($Post^{2+} \times Treat$ only), suggesting that the results in Table 3 take place only after adoption of the regulation. Moreover, the reduction becomes stronger two years afterward, consistent with long production cycles for innovation projects (Holmstrom, 1989; Chava et al., 2013).

4.3 Falsification Tests

One concern is that our results may be influenced by the 2007-2008 financial crisis. The crisis may have influenced consolidating banks more adversely because they engaged in more securitizations than the non-consolidating banks, hampering their credit supply even in the absence of the new regulation. Continuation of the differential impacts after 2010 might explain our findings. This concern is alleviated in several ways. First, our sample period does not contain pre-crisis years. Since the new regulation was implemented at the beginning of 2010 when the economy was recovering, it is less likely to find a decline in firms' innovation activities during the post-regulation period. Second, we include banks' total securitized assets as a matching variable when performing the propensity score matching, and control for this variable during the analysis of innovation.

Third, although consolidating banks, compared with other securitizing banks, have more credit card securitization, they do not suffer more from the liquidity dry-ups during the recent financial crisis because the meltdown of home mortgage securitization is more severe than that of credit card securitization. The flow of funds accounts report that total

securitization of home mortgages declined from $2.2 trillion at the beginning of 2007 to $1.6 trillion at the end of 2009, compared to total consumer credit securitization from $617 billion to $572 billion over the same period.

Fourth, Purnanandam (2011) shows that when securitization markets were disrupted, banks that were unable to unload loans of inferior quality experienced poor performance and high charge-offs. We compare changes in bank ROA and loan charge-offs from the pre- to the post-regulation period between consolidating and non-consolidating banks that issue loans to our sample firms. The untabulated results show no significantly different changes in these variables between the two types of banks (t-value = -0.50 and 0.14, for bank ROA and loan chargeoffs, respectively).

Finally, we conduct falsification tests to check whether our results disappear when using the year preceding the crisis (i.e., 2006) as the pseudo effective year of the regulation. Affected banks are assumed to consolidate securitization entities in 2006. We examine the sample period of 2003-2009 and identify the treatment and control firms in a similar way as in Section 3.2. We use the same propensity score matching method to obtain a matched sample of treatment and control firms. Since the pseudo post-event period perfectly coincides with the financial crisis, we should observe similar effects if the crisis is the reason for declines in the innovation of treatment firms. Table 5 shows that the coefficients on $Post \times Treat$ are statistically insignificant, suggesting that the financial crisis unlikely explains our results.

5 Heterogeneous Impacts

Up to this point, the results suggest that removing off-balance-sheet treatment of securitization hinders borrowers' innovation by imposing regulatory costs and market discipline on banks and thus exacerbating borrowers' financing difficulties. In this section, we explore cross-sectional variations in factors that underlie this interpretation: downward pressure on banks' capital ratios due to consolidation, the strength of market discipline over banks, and borrowers' dependence on external finance.

5.1 Downward Pressure on Banks' Capital Ratios

As explained in Section 2.1., consolidation of off-balance-sheet securitization brings down banks' capital ratios. To estimate the impact on a bank's tier 1 leverage capital ratio, we take the difference between the ratio as if the regulation had not been implemented ("$as\,if$" $tier\,1\,capital\,ratio$) and the reported capital ratio. The "$as\,if$" $tier\,1\,capital\,ratio$ is computed as the tier 1 capital plus the loan loss reserves of the consolidated assets, divided by bank total assets minus net consolidated assets.

$$\begin{aligned} Impacts &= \text{“}as\,if\text{”}\ tier\,1\,capital\,ratio - tier\,1\,reported\,capital\,ratio \\ &= \frac{tier\,1\,capital + reserves\,for\,consolidated\,assets}{bank\,total\,assets - net\,consolidated\,assets} - \frac{tier\,1\,capital}{bank\,total\,assets.} \end{aligned}$$

The estimated average impact of the regulation is a decrease of one percentage point in the tier 1 leverage capital ratio of consolidating banks. The impact value is first assigned at the firm-bank-year level and then averaged to the firm-year level, as discussed in Section 3.2. Treatment firms that borrow from banks facing above median downward pressure due

to consolidation and their matched control firms are classified into the high downward pressure subsample, and rest are classified into the low downward pressure subsample.

We estimate equation (1) separately for the two subsamples and report the results in Table 6. The coefficients on $Post \times Treat$ are negative and statistically significant in all specifications for firms in the high downward pressure subsample. In contrast, the coefficients are mostly insignificant, except for the $Patent_{t+1}$ specification, for firms in the low downward pressure subsample. The results indicate that the innovation activities of firms that borrow from banks with a larger consolidation impact on capital ratios are affected more.

5.2 The Strength of Market Discipline

To the extent that market participants view on-balance-sheet assets as riskier than off-balance-sheet ones (Barth et al., 2012; Callahan et al., 2012; Bonsall et al., 2017), consolidation of securitized assets likely increases market discipline over banks (e.g., by increasing the cost of capital), pressuring banks to reduce their credit supply. We measure the strength of market discipline as uninsured deposits scaled by bank total assets, since uninsured depositors are viewed as major participants who monitor and discipline banks (Berger and Turk-Ariss, 2015; Akins et al., 2017).[16] Similar to the previous section, the value is first assigned at the firm-bank-year level and then averaged to the firm-year level. Treatment firms that borrow from banks with above median uninsured deposits and their matched control firms are classified into the high market discipline subsample, and rest are classified into the low market discipline subsample.

[16]Using short-term funding (borrowed money with a remaining maturity of one year or less) as an alternative measure of the strength of market discipline does not alter our inference.

We estimate equation (1) separately for the two subsamples and report the results in Table 7. The coefficients on $Post \times Treat$ are negative and statistically significant in all specifications for firms in the high market discipline subsample. In contrast, the coefficients are mostly insignificant, except for the *Patent* specifications, for firms in the low market discipline subsample. The magnitude of the coefficients in Panel A is much larger than that in Panel B, suggesting that the innovation activities of firms that borrow from banks under greater market discipline are affected more.

5.3 External Finance Dependence

If the reduced credit supply resulting from banks' consolidation constrains firms from engaging in more innovation activities, firms more dependent on external finance should be affected more. To test this prediction, we estimate equation (1) for firms in high and low external finance dependent industries separately. We measure an industry's dependence on external capital using the median value of the external finance needs of all firms in the three-digit SIC code industry in each year. A firm's need for external finance in a year is computed as the fraction of investments not financed through internal cash flow.[17] Industries with external finance dependence above (below) the median value are considered as high (low) external finance dependent industries.

As shown in Table 8, for firms with a high dependence on external finance, the coefficients on $Post \times Treat$ are negative and statistically significant in all specifications except for $Citations_{t+2}$. In contrast, the coefficient is significant only in the R&D specification

[17]Investments here include capital expenditures, R&D expenses, and acquisition. The internal capital flow is measured as income before extraordinary items plus depreciation and deferred taxes. We find similar results using alternative definitions of external finance dependence.

for firms with low dependence on external finance. Comparing the coefficients on the interaction term across the two subsamples, banks' consolidation of securitized assets has a much stronger impact on the innovation of firms with a higher need for external capital.

6 Financing Mechanism

In this section, we explore the underlying financing mechanism through which banks' consolidation of securitized assets affects firm innovation. Specifically, we investigate how bank lending serves as a channel to transmit the effect of consolidation.

6.1 Bank Lending

We pool all the loans extended to the matched treatment and control firms during the sample period and conduct the analysis at the loan level. We measure the loan pricing (*Spread*) as the natural logarithm of the *all-in-drawn-spread* variable in DealScan, which is the spread of the facility over LIBOR, inclusive of annual fees. The size of a loan (*Amount*) is measured as the natural logarithm of the $FacilityAmt$ variable in DealScan. Using the two metrics as dependent variables, we estimate a modified equation (1), augmented with bank fixed effects and loan type fixed effects (i.e., whether a loan is a term loan, a revolving credit line, or else).[18] The variable of interest is $Post \times Treat$, in which $Treat$ is a time-invariant indicator equal to one for loans from consolidating banks.

As shown in Table 9, the coefficient on $Post \times Treat$ is positive and statistically significant for loan spreads, and negative and statistically significant for loan amounts. These results suggest that after the regulation, consolidating banks offer 39.8% ($= e^{0.3354} -$

[18] Since we conduct the analysis at the loan level, there is no need to average bank characteristics.

1) higher loan spreads and extend 54% ($= e^{-0.6080} - 1$) smaller loans, in comparison to non-consolidating banks.[19] Together, the results support the notion that the new regulation is associated with a sizable decline in the credit supply, whereby removing off-balance-sheet treatment of banks securitization decreases firm innovation.

6.2 Matched Banks

We next examine whether banks that are affected by the regulation might be different from the unaffected banks, despite our use of a battery of bank characteristics and bank fixed effects as controls in our regressions. To investigate this possibility, we use all banks from Y-9C reports and match banks using propensity scores based on the mean values of securitized assets, bank size, capital ratios, bank ROA, charge-offs, and C&I loans before 2010, the implementation year of the new regulation (i.e., 2007-2009). The descriptive statistics for the 82 matched pairs of banks are reported in Panel A of Table 10. The matched banks have similar characteristics before the regulation.

We then pool all loans originated by these banks from DealScan. Using this sample of loans from matched banks, we re-estimate the specifications of bank lending.[20] As shown in Table 10, the loans of affected banks exhibit higher yield spreads and lower loan amounts than those of matched control banks from the pre-regulation to the post-regulation periods. Thus, our results are unlikely to be affected by the differences between affected and unaffected banks.

[19] If we use the share or the number of syndicate participants as the dependent variable, $Post \times Treat$ does not load, suggesting no change in credit supply of participants

[20] To maintain a large sample, we do not restrict our sample to only firms in Compustat. Consequently, we only control for firm fixed effects, not firm characteristics.

7 Concurrent Events

During our 2007-2013 sample period, real estate prices plunged initially and then slowly recovered. Meanwhile, policymakers enacted a series of financial reforms aimed at stabilizing the financial system and rebuilding investors' confidence. As these regulatory changes might also affect bank lending and firm innovation, in this section, we investigate the resilience of our results to accounting for potential impacts of five concurrent events.

7.1 Real Estate Prices

The boom in real estate prices in the years leading up to the 2007-2008 financial crisis and the collapse of the housing bubble during the crisis had a direct impact on mortgage markets and financial institutions. A large drop in real estate prices led to a deterioration in banks' balance sheets and affected their lending capacity. Gan (2007) finds that banks with greater real estate exposure reduce lending when there is a decline in real estate prices. Since housing prices fluctuate substantially during our sample period, we examine whether banks' exposure to real estate prices explains our findings.

We measure the exposure of banks to real estate markets using the state-level House Price Index (HPI) from the Federal Housing Finance Agency and the Summary of Deposits data. We construct the deposit-weighted exposure index for each bank using changes in state-level HPI in 2010 with the percentage of deposits in each state as weights. For lending analyses (at the loan level), the variable *Low Exposure* is equal to one for loans of banks with the deposit-weighted exposure index below the median value, and zero otherwise. For innovation analyses (at the firm level), the exposure index is averaged to

the firm-year level weighted by the prevailing loan amounts borrowed from each bank; *Low Exposure* is equal to one for firms with the average index below the median value, and zero otherwise. We add *Low Exposure* and its interaction with an indicator for the post-regulation period (*Post*) to the regression models.

Columns (1)–(3) and columns (4)–(5) of all panels of Table 11 report the estimation results for firm innovation and bank lending, respectively. Panel A shows that our results still hold when we control for *Low Exposure* and *Low Exposure* × *Post*. In lending analyses, *Low Exposure* is absorbed by bank fixed effects. The results suggest that the effect of eliminating off-balance-sheet treatment is distinct from that of differential exposure to real estate markets.

7.2 Basel III

In response to the 2007-2008 financial crisis, the Basel Committee on Banking Supervision developed a reform program to strengthen the resilience of banks and the global banking system (known as Basel III). Basel III includes provisions designed to increase the regulatory capital requirements associated with the originate-to-distribute model. One such provision increases the risk-weight of the mortgage servicing rights (MSRs) held by banks from 100% to 250% and decreases the cap on a bank's MSRs from 50% of its Tier 1 capital to 10%. As a result, the regulatory costs associated with holding MSRs would increase substantially according to the estimation by Mortgage Bankers Association (2012). Hendricks et al. (2016) show that the Basel III reform measures impose more regulatory pressure on 16 banks with a ratio of MSRs to tier 1 capital exceeding 10%, in comparison to other banks.

We follow Hendricks et al. (2016) to capture the differential regulatory pressure faced by banks. For lending analyses, the variable $RegPressure$ is equal to one for the loans of the 16 banks, and zero otherwise. For innovation analyses, $RegPressure$ is equal to one for firms that borrow from the 16 banks, and zero otherwise. We add $RegPressure$ and its interaction with the $Post$ indicator to the regression models. In lending analyses, $RegPressure$ is absorbed by bank fixed effects. As shown in Panel B of Table 11, our results are robust to controlling for $RegPressure$ and $RegPressure \times Post$, indicating that the impacts of removing off-balance-sheet treatment on bank lending and firm innovation are not driven by the Basel III reform measures.

7.3 Dodd-Frank Act

The Dodd-Frank Act is another important regulatory reform that affects the U.S. regulatory structure and the financial sector. The Act prohibits depository banks from proprietary trading and limits their' investments in private equity and hedge funds to no more than 3% of the Tier 1 capital. Systemically important financial institutions are subject to enhanced prudential regulation and have to prepare resolution plans (also known as "living wills") that bankruptcy courts can follow in case of severe financial distress. The Act also imposes more stringent regulatory capital requirements, greater transparency for derivative instruments, and more "skin in the game" for originators of ABSs. See Acharya et al. (2010) for detailed discussions on the implications of the Act.

To the extent that the Dodd-Frank Act imposes onerous regulatory requirements on banks, we investigate whether our results are driven by this legislation. We measure the impact of the regulatory reform using market-adjusted three-day cumulative abnormal

returns centered around the 17 key events leading up to the adoption of the Act, as identified by Schafer et al. (2016). For lending analyses, we compute the sum of the cumulative abnormal returns for each bank and assigned the value to its loans ($CAR\ Dodd\text{-}Frank$). For innovation analyses, the value is averaged to the firm-year level weighted by the prevailing loan amounts borrowed from each bank. In lending analyses, $CAR\ Dodd\text{-}Frank$ is absorbed by bank fixed effects. The inclusion of $CAR\ Dodd\text{-}Frank$ and its interaction with the *Post* indicator do not change our results (Panel C of Table 11), indicating that the implementation of the Act cannot explain our findings.

7.4 Stress Tests

The Federal Reserve System conducted the first stress test, the Supervisory Capital Assessment Program (SCAP), in 2009. The test assessed the capital adequacy of 19 bank holding companies with assets above $100 billion. No stress test was conducted in 2010. The program then evolved into the Comprehensive Capital Analysis and Review (CCAR). During 2011-2013, the annual CCARs involved BHCs with assets exceeding $100 billion at the time of the 2009 SCAP.

To assess whether the stress tests explain our findings, we collect stress test data from the Federal Reserve System (Bird et al., 2015). For lending analyses, the variable $StressTest$ is equal to one for loans of banks subject to the stress tests, and zero otherwise. For innovation analyses, $StressTest$ is equal to one for firms that borrow from banks subject to the stress tests in that year, and zero otherwise. We add $StressTest$ and its interaction with the *Post* indicator to the regression models. As shown in Panel D of Table 11, our results are robust to controlling for $StressTest$ and $StressTest \times Post$,

suggesting that consolidating off-balance-sheet securitized assets has an impact on bank lending and firm innovation beyond that of the stress tests.

7.5 Troubled Asset Relief Program

In October 2008, the Emergency Economic Stabilization Act of 2008 created the $700 billion Troubled Asset Relief Program (TARP) to purchase illiquid, difficult-to-value assets from banks and other financial institutions. The Dodd-Frank Act reduced the amount authorized to $475 billion. The TARP was designed to help stabilize the U.S. financial system and prevent avoidable foreclosures.

To control for the effects of TARP, we collect TARP participation data from the U.S. Department of Treasury. For lending analyses, the variable $TARP$ is equal to one for the loans of banks that participate in the TARP program in that year, and zero otherwise. For innovation analyses, $TARP$ is equal to one for firms that borrow from banks participating in the TARP program in that year, and zero otherwise. As shown in Panel E of Table 11, our results are robust to controlling for $TARP$ and its interaction with the *Post* indicator, suggesting that banks' participation in TARP does not have a demonstrable effect on our findings.

In untabulated analyses, we find that our results are robust to controlling for all five events simultaneously. Taken together, the effects of removing off-balance-sheet treatment on bank lending and firm innovation cannot be attributed to those concurrent events.

8 Conclusion

In this paper, we examine how corporate innovation is influenced by off-balance-sheet treatment of banks' securitization. Exploiting a recent regulation (SFAS Nos. 166 and 167 and associated bank regulatory decisions) that brings previously off-balance-sheet securitized assets onto banks' financial statements and subjects them to full regulatory capital charges, we find a reduction in innovation for firms that borrow from affected banks. The reduction in innovation is concentrated among firms whose lenders experience more downward pressure on regulatory capital ratios and greater market discipline, and firms that are more dependent on external finance. Further analysis indicates that firms borrowing from affected banks experience an increase in the costs of debt and a decrease in loan amounts. The findings are robust to various specifications and alternative measures of firm innovation. Taken together, the results indicate that off-balance-sheet securitization affects borrowing firms' innovation by lowering their financing costs and increasing the funds that are available.

While many studies demonstrate the dark side of the off-balance-sheet treatment of securitization, the benefits from such treatment are largely overlooked. We provide evidence that eliminating the off-balance-sheet status of some securitized assets can have unintended consequences on the economy by hindering innovative activities. We hope that our findings will encourage a more nuanced consideration of costs and benefits when designing accounting and regulatory rules for securitization.

Appendix A: Definitions of Variables

Items in parentheses are variable names as in the Compustat annual database, DealScan loan database, FR Y-9C and Call Reports.

Firm Variables

$ln(Sales)$ = natural logarithm of net sales (sale)

M/B = market value of assets / total assets (at), where market value of assets is given by total assets (at) - common equity (ceq) + market value of common equity (common shares outstanding (csho) × share price (prcc))

CF = [income before extraordinary items (ibc) + depreciation and amortization (dp)] ×100 / lagged total assets (at)

PPE = net property, plant and equipment (ppent) ×100/ total assets (at)

$S.Growth$ = $ln(sale_t)$ - $ln(sale_{t-1})$

$Leverage$ = [short-term debt (dlc) + long-term debt (dltt)] ×100/ total assets (at)

$Cash$ = cash and cash Equivalents (che) ×100/ total assets (at)

$\Delta R\&D$ =[R&D expense (xrd)-lagged R&D expense ×100]/ lagged total assets (at)

$\Delta Other\ Investments$ =[Other Investments (capx+aqc)-lagged Other Investments ×100]/ lagged total assets (at)

Innovation Variables

$R\&D$ = R&D (xrd) ×100/ lagged total assets (at)

$Patent$ = natural logarithm of one plus the number of patents applied by the firm

$Citations$ = natural logarithm of one plus truncation bias-adjusted citations. The truncation bias-adjusted citations is citations per patent divided by the number of citations in the same year and technology class

Test Variables

$Treat$ = an indicator equal to one for firms borrowing from banks that consolidate securitization entities under the new regulation, and zero otherwise in innovation analyses; an indicator equal to one for loans of banks that consolidate securitization entities under the new regulation, and zero otherwise in lending analyses.

$Post$ = an indicator equal to one for the post-regulation period (2010-2013), and zero otherwise (2007-2009)

Loan Variables

$Spread$ = natural logarithm of all-in-drawn spread (AllInDrawn)

$Amount$ = natural logarithm of facility amounts (FacilityAmt)

Bank Variables
The value of all bank variables are assigned to the loan level for lending analyses or averaged to the firm-year level weighted by the prevailing loan amounts borrowed from each bank for innovation analyses. The mnemonics below are from call reports and all mnemonics from Y-9Cs are prefixed by bhck.

$Securitized\ Assets$ = [sum of off-balance-sheet securitized assets (rcfdb705 through rcfdb711) + assets in consolidated Variable Interest Entities under SFAS Nos. 166 and 167 (sum of rcfdj981 though rcfdj998, rcfdk003 through rcfdk014, and rcfdk030 through rcfdk032), + maximum amount of credit exposure arising from credit enhancements provided to ABCP conduits (rcfdb806)] ×100/ total assets (rcfd2170)

$Bank\ Size$ = natural logarithm of total assets (rcfd2170)

$Capital\ Ratio$ = total equity capital (rcfd3210)×100/ total assets (rcfd2170)

$Bank\ ROA$ = net income (riad4340) ×100/ total assets (rcfd2170)

$Charge\text{-}off$ = [charge-offs on allowance for loan and lease losses (riad4635) − recoveries on allowance for loan and lease losses (riad4605)] ×100/ total assets (rcfd2170)

$C\&I\ Loans$ = commercial and industrial loans (rcfd1766) ×100/ total assets (rcfd2170)

$Uninsured\ Deposits$ = total deposits $100,000 or more (rcon2604) ×100/ total assets (rcfd2170)

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Figure 1: Off-Balance-Sheet Treatment of Securitization, Capital Ratios, and Bank Lending

This figure illustrates how off-balance-sheet treatment affects regulatory capital ratios and bank lending capacity. Example 1 (*Ex1: No Securitization*) presents a balance sheet of a bank holding $100 million of loan assets funded by $90 million of deposits and $10 million of equity to maintain a target capital ratio of 10%. Example 2 (*Ex2: Securitization with or without OBS treatment*) presents a balance sheet of the bank, which securitizes $20 million of existing loans using ABS, with $20 million of cash from deposits freed up for new lending. With off-balance-sheet treatment, the capital ratio is intact, whereas without off-balance-sheet treatment, the capital ratio declines to 8.3%. Example 3 (*Ex3: Securitization without OBS treatment, deposits paid off*) presents a balance sheet of the bank, which securitizes $20 million of existing loans using ABS and pay off deposits using $20 million of cash, in order to maintain the target capital ratio of 10% without off-balance-sheet treatment.

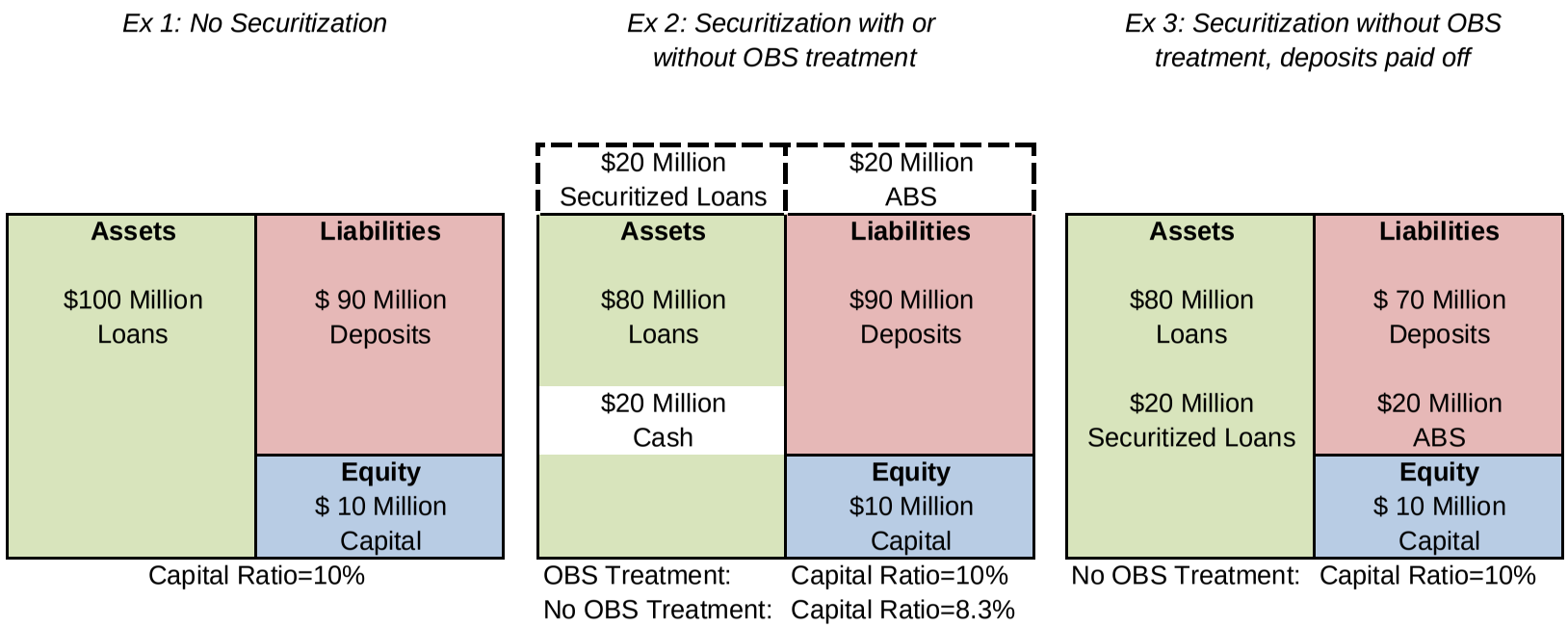

Table 1:
Summary Statistics

This table reports quality of matching and summary statistics of firm, bank, and loan variables. Panel A presents the differences in characteristic variables for the unmatched raw sample and the matched sample in the pre-regulation period (2007-2009). Treated firms are firms borrowing from banks affected by the new regulation. Control firms are firms borrowing from unaffected banks. The matched sample are constructed using the propensity score matching method based on averages of sales, market-to-book, cash flows, PPE, sales growth, leverage, cash holdings, changes in R&D, changes in other investments, and lenders' securitized assets prior to the regulation for firms in the same 3-digit SIC code industry. The mean values of variables used in matching are reported. $Diff$ is the differences in the mean values. *t-Stat* is t-statistics of t-tests. Panel B reports firm characteristics, bank characteristics (averaged to the firm level), and loan characteristics (at the loan level) for the sample of matched firms during 2007-2013. The definitions of variables are in the Appendix. CF, PPE, *Leverage*, *Cash*, *R&D*, *Securitized Assets*, *Capital Ratio*, *BankROA*, *Charge-off*, and *C&I Loans* are reported in percentage.

		Panel A: Quality of Matching			
		Treated	Control	Diff	t-Stat
ln(Sales)	Raw	7.76	7.07	0.69	5.21
	Matched	7.87	7.36	0.51	2.58
M/B	Raw	1.60	1.52	0.07	1.29
	Matched	1.67	1.69	-0.03	-0.31
PPE	Raw	33.01	30.55	2.46	1.31
	Matched	32.52	34.88	-2.36	-0.79
CF	Raw	9.58	6.39	3.19	3.62
	Matched	10.27	9.84	0.43	0.44
S.Growth	Raw	0.04	0.01	0.02	1.16
	Matched	0.05	0.03	0.02	0.46
Leverage	Raw	26.62	30.46	-3.85	-2.24
	Matched	25.20	26.59	-1.39	-0.69
Cash	Raw	8.52	10.92	-2.40	-2.96
	Matched	9.11	8.21	0.90	0.90
ΔR&D	Raw	0.06	0.00	0.05	0.97
	Matched	0.05	0.06	-0.01	-0.07
ΔOther Investments	Raw	0.35	0.06	0.29	0.59
	Matched	0.48	0.32	0.16	0.21
Securitized Assets	Raw	21.73	19.95	1.78	1.67
	Matched	21.61	20.61	1.00	0.64

Panel B: The Matched Sample				
	Mean	Median	Std Dev	Observations
Firm Characteristics				
ln(Sales)	7.60	7.56	1.67	2420
M/B	1.66	1.43	0.81	2405
CF	9.76	10.32	9.57	2389
PPE	32.92	24.28	25.36	2422
S.Growth	0.05	0.05	0.22	2418
Leverage	26.81	25.15	18.88	2422
Cash	9.79	6.67	10.11	2422
Innovation Measures				
R&D	1.76	0.00	3.63	2422
Number of Patent	34.52	0.00	326.34	2422
Number of Citations	60.56	0.00	663.10	2422
Bank Characteristics				
ROA	0.48	0.54	0.52	2368
Capital Ratio	8.78	8.74	2.47	2368
C&I Loans	8.52	7.80	4.47	2368
Size	19.21	21.15	4.10	2368
Charge-off	0.72	0.58	0.51	2367
Securitized Assets	17.62	14.57	13.76	2368
Loan Characteristics				
Spread	5.17	5.30	0.79	1416
Amount	19.59	19.60	1.33	1509

Table 2:
Industry Distribution

This table reports industry distribution of firms in the matched sample based on two-digit SIC codes.

2-digit SIC	Industry	Frequency	Percent
13	Oil and Gas Extraction	238	9.83
14	Mining and Quarrying of Nonmetallic Minerals, Except Fuels	14	0.58
17	Construction - Special Trade Contractors	14	0.58
20	Food and Kindred Products	70	2.89
23	Apparel, Finished Products from Fabrics & Similar Materials	42	1.73
24	Lumber and Wood Products, Except Furniture	14	0.58
25	Furniture and Fixtures	28	1.16
26	Paper and Allied Products	42	1.73
27	Printing, Publishing and Allied Industries	28	1.16
28	Chemicals and Allied Products	168	6.94
29	Petroleum Refining and Related Industries	56	2.31
30	Rubber and Miscellaneous Plastic Products	14	0.58
31	Leather and Leather Products	14	0.58
33	Primary Metal Industries	28	1.16
34	Fabricated Metal Products	70	2.89
35	Industrial and Commercial Machinery and Computer Equipment	182	7.51
36	Electronic & Other Electrical Equipment & Components	98	4.05
37	Transportation Equipment	84	3.47
38	Measuring, Photographic, Medical, & Optical Goods, & Clocks	168	6.94
39	Miscellaneous Manufacturing Industries	28	1.16
40	Railroad Transportation	28	1.16
42	Motor Freight Transportation	42	1.73
44	Water Transportation	14	0.58
45	Transportation by Air	42	1.73
48	Communications	56	2.31
50	Wholesale Trade - Durable Goods	84	3.47
51	Wholesale Trade - Nondurable Goods	14	0.58
52	Building Materials, Hardware, Garden Supplies & Mobile Homes	14	0.58
53	General Merchandise Stores	56	2.31
55	Automotive Dealers and Gasoline Service Stations	28	1.16
56	Apparel and Accessory Stores	42	1.73
58	Eating and Drinking Places	84	3.47
59	Miscellaneous Retail	84	3.47
72	Personal Services	14	0.58
73	Business Services	238	9.83
75	Automotive Repair, Services and Parking	14	0.58
79	Amusement and Recreation Services	70	2.89
80	Health Services	28	1.16
82	Educational Services	14	0.58
87	Engineering, Accounting, Research, and Management Services	28	1.16
99	Nonclassifiable Establishments	28	1.16
Total		2422	100

Table 3:
Consolidation and Innovation

This table reports the effects of lenders' consolidation of securitization entities on firm innovation based on the matched sample of treatment and control firms. The dependent variables are *R&D*, *Patent*, and *Citations*. *Post* is an indicator equal to one for the post-regulation period and zero otherwise. *Treat* is an indicator equal to one if the firm borrows from a lender that consolidates securitization entities under the new regulation and zero otherwise. A set of firm characteristic variables and bank characteristic variables are controlled for. Bank variables are weighted by the prevailing facility amount if a firm borrows from multiple lenders in a given year. Firm fixed effects and industry-year fixed effects are included. Clustered standard errors at the industry level are reported in the brackets. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

	$R\&D_t$	$Patent_{t+1}$	$Patent_{t+2}$	$Citations_{t+1}$	$Citations_{t+2}$	$R\&D_t$	$Patent_{t+1}$	$Patent_{t+2}$	$Citations_{t+1}$	$Citations_{t+2}$
Post×Treat	-0.2941**	-0.1544***	-0.1431***	-0.0460***	-0.0284*	-0.2815*	-0.1539***	-0.1407***	-0.0481***	-0.0268
	[0.1268]	[0.0395]	[0.0395]	[0.0159]	[0.0153]	[0.1480]	[0.0412]	[0.0432]	[0.0163]	[0.0180]
ln(Sales)	-0.5879	0.0593	-0.0021	0.0398	0.0209	-0.6708	0.0658	0.0038	0.0342	0.0169
	[0.3788]	[0.0693]	[0.0909]	[0.0318]	[0.0247]	[0.4460]	[0.0737]	[0.0996]	[0.0370]	[0.0304]
M/B	0.4347***	-0.0085	-0.0152	0.0174*	0.0008	0.4984***	-0.0139	-0.0151	0.0180*	0.0013
	[0.1269]	[0.0335]	[0.0250]	[0.0096]	[0.0152]	[0.1260]	[0.0363]	[0.0266]	[0.0102]	[0.0177]
CF	-0.0020	-0.0007	0.0016**	-0.0006	0.0000	-0.0029	-0.0008	0.0016	-0.0007	0.0000
	[0.0039]	[0.0013]	[0.0008]	[0.0006]	[0.0006]	[0.0038]	[0.0014]	[0.0010]	[0.0006]	[0.0007]
PPE	0.0134	0.0042**	0.0032	-0.0007	0.0003	0.0077	0.0050**	0.0053**	-0.0012	0.0003
	[0.0177]	[0.0019]	[0.0023]	[0.0006]	[0.0011]	[0.0158]	[0.0020]	[0.0025]	[0.0008]	[0.0010]
S.Growth	0.0726	0.0040	-0.0393	0.0008	-0.0227	0.1301	0.0092	-0.0158	0.0014	-0.0187
	[0.0804]	[0.0558]	[0.0526]	[0.0225]	[0.0171]	[0.1216]	[0.0561]	[0.0532]	[0.0226]	[0.0177]
Leverage	-0.0052**	0.0000	0.0019	0.0002	0.0003	-0.0040	-0.0003	0.0015	0.0002	0.0004
	[0.0025]	[0.0011]	[0.0015]	[0.0006]	[0.0005]	[0.0030]	[0.0011]	[0.0014]	[0.0005]	[0.0005]
Cash	0.0292	0.0006	0.0009	-0.0005	0.0005	0.0237	0.0010	0.0025	-0.0004	0.0009
	[0.0267]	[0.0016]	[0.0031]	[0.0009]	[0.0010]	[0.0288]	[0.0017]	[0.0027]	[0.0011]	[0.0010]
Bank ROA						-0.0947	-0.0024	0.0003	-0.0059	-0.0127
						[0.0593]	[0.0278]	[0.0298]	[0.0181]	[0.0173]
Bank Capital Ratio						0.0154	0.0148*	0.0146	0.0045	-0.0033
						[0.0270]	[0.0078]	[0.0127]	[0.0035]	[0.0072]
C&I Loans						0.0205	-0.0009	0.0019	-0.0010	-0.0008
						[0.0302]	[0.0037]	[0.0041]	[0.0024]	[0.0030]
Bank Size						0.0008	-0.0073	-0.0048	-0.0067	-0.0006
						[0.0419]	[0.0058]	[0.0072]	[0.0050]	[0.0039]
Charge-off						0.0692	-0.0329	-0.0283	0.0052	0.0206
						[0.2716]	[0.0423]	[0.0470]	[0.0169]	[0.0234]
Securitized Assets						0.0065*	0.0004	0.0006	0.0001	-0.0002
						[0.0037]	[0.0012]	[0.0016]	[0.0005]	[0.0007]
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,360	2,022	1,687	2,022	1,687	2,294	1,974	1,648	1,974	1,648
Adjusted R^2	0.8841	0.9509	0.9517	0.3617	0.3121	0.8836	0.9505	0.9525	0.3759	0.3179

Table 4:
Dynamic Effects

This table presents the dynamic effects of lenders' consolidation of securitization entities on firm innovation. The dependent variables are $R\&D$, $Patent$, and $Citations$. Pre is an indicator equal to one for one year before the regulation and zero otherwise. $Post^0$, $Post^1$, and $Post^{2+}$ are indicators that capture the years subsequent to the regulation. $Treat$ is an indicator equal to one if the firm borrows from a lender that consolidates securitization entities under the new regulation and zero otherwise. A set of firm characteristics, including $ln(Sales)$, M/B, CF, PPE, $S.Growth$, $Leverage$, and $Cash$, and bank characteristics, including $Securitized\ Assets$, $Bank\ size$, $Capital\ Ratio$, $Bank\ ROA$, $Charge\text{-}off$, and $C\&ILoans$ are controlled for. Bank characteristics are weighted by the prevailing facility amount if a firm borrows from multiple lenders in a given year. Firm fixed effects and industry-year fixed effects are included. Clustered standard errors at the industry level are reported in the brackets. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

	(1)	(2)	(3)
	R&D	Patent	Citations
Pre×Treat	-0.0227	0.0322	0.0036
	[0.0759]	[0.0387]	[0.0212]
$Post^0$×Treat	-0.0546	-0.0007	-0.0319
	[0.0954]	[0.0366]	[0.0225]
$Post^1$×Treat	-0.2999*	-0.0307	-0.0306
	[0.1519]	[0.0402]	[0.0193]
$Post^{2+}$×Treat	-0.3304*	-0.1075**	-0.0525***
	[0.1821]	[0.0408]	[0.0184]
Firm Characteristics	Yes	Yes	Yes
Bank Characteristics	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Industry-Year FE	Yes	Yes	Yes
Observations	2,294	2,294	2,294
Adjusted R^2	0.8834	0.9482	0.4053

Table 5:
Falsification Test

This table reports the estimation results of placebo tests based on a matched sample of treatment and control firms during 2003-2009. Banks that consolidate their off-balance-sheet securitization entities under the regulation are assumed to start the consolidation in 2006. The dependent variables are $R\&D$, $Patent$, and $Citations$. $Post$ is an indicator equal to one for the post-pseudo-consolidation period and zero otherwise. $Treat$ is an indicator equal to one if the firm borrows from a consolidating lender and zero otherwise. A set of firm characteristics, including $ln(Sales)$, M/B, CF, PPE, $S.Growth$, $Leverage$, and $Cash$, and bank characteristics, including $Securitized\ Assets$, $Bank\ size$, $Capital\ Ratio$, $Bank\ ROA$, $Charge\text{-}off$, and $C\&ILoans$ are controlled for. Bank characteristics are weighted by the prevailing facility amount if a firm borrows from multiple lenders in a given year. Firm fixed effects and industry-year fixed effects are included. Clustered standard errors at the industry level are reported in the brackets. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

	$R\&D_t$	$Patent_{t+1}$	$Patent_{t+2}$	$Citations_{t+1}$	$Citations_{t+2}$
Post×Treat	-0.0514	0.0273	0.0522	-0.0083	0.0169
	[0.1982]	[0.0351]	[0.0346]	[0.0192]	[0.0176]
Firm Characteristics	Yes	Yes	Yes	Yes	Yes
Bank Characteristics	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Industry-Year FE	Yes	Yes	Yes	Yes	Yes
Observations	1,820	1,562	1,297	1,562	1,297
Adjusted R^2	0.6954	0.9476	0.9527	0.5849	0.5775

Table 6:
Downward Pressure on Lenders' Capital Ratios

This table presents the effects of lenders' consolidation of securitization entities on innovation of firms whose lenders face high versus low downward pressure on their capital ratios. Treatment firms that borrow from lenders facing above median downward pressure on tier 1 capital ratios due to consolidation, and their matched control firms are classified into the high downward pressure sample (Panel A) and those otherwise into low downward pressure sample (Panel B). The dependent variables are $R\&D$, $Patent$, and $Citations$. $Post$ is an indicator equal to one for the post-regulation period and zero otherwise. $Treat$ is an indicator equal to one if the firm borrows from a lender that consolidates securitization entities under the new regulation and zero otherwise. A set of firm characteristics, including $ln(Sales)$, M/B, CF, PPE, $S.Growth$, $Leverage$, and $Cash$, and bank characteristics, including $Securitized\ Assets$, $Bank\ size$, $Capital\ Ratio$, $Bank\ ROA$, $Charge\text{-}off$, and $C\&I Loans$ are controlled for. Bank characteristics are weighted by the prevailing facility amount if a firm borrows from multiple lenders in a given year. Firm fixed effects and industry-year fixed effects are included. Clustered standard errors at the industry level are reported in the brackets. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

	Panel A: High Downward Pressure				
	$R\&D_t$	$Patent_{t+1}$	$Patent_{t+2}$	$Citations_{t+1}$	$Citations_{t+2}$
Post×Treat	-0.6516***	-0.1894***	-0.2239***	-0.0782***	-0.0689***
	[0.2248]	[0.0558]	[0.0607]	[0.0198]	[0.0238]
Firm Characteristics	Yes	Yes	Yes	Yes	Yes
Bank Characteristics	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Industry-Year FE	Yes	Yes	Yes	Yes	Yes
Observations	1,138	979	815	979	815
Adjusted R^2	0.9063	0.9592	0.9598	0.3989	0.3423

	Panel B: Low Downward Pressure				
	$R\&D_t$	$Patent_{t+1}$	$Patent_{t+2}$	$Citations_{t+1}$	$Citations_{t+2}$
Post×Treat	-0.0024	-0.1211*	-0.0664	-0.0286	-0.0059
	[0.1652]	[0.0652]	[0.0584]	[0.0238]	[0.0233]
Firm Characteristics	Yes	Yes	Yes	Yes	Yes
Bank Characteristics	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Industry-Year FE	Yes	Yes	Yes	Yes	Yes
Observations	1,123	967	809	967	809
Adjusted R^2	0.8734	0.9368	0.9382	0.2811	0.2324

Table 7:
The Strength of Market Discipline

This table presents the effects of lenders' consolidation of securitization entities on innovation of firms whose lenders face high versus low market discipline. Treatment firms that borrow from lenders with above median uninsured deposits, and their matched control firms are classified into the high uninsured deposits sample (Panel A) and those otherwise into low uninsured deposits sample (Panel B). The dependent variables are $R\&D$, $Patent$, and $Citations$. $Post$ is an indicator equal to one for the post-regulation period and zero otherwise. $Treat$ is an indicator equal to one if the firm borrows from a lender that consolidates securitization entities under the new regulation and zero otherwise. A set of firm characteristics, including $ln(Sales)$, M/B, CF, PPE, $S.Growth$, $Leverage$, and $Cash$, and bank characteristics, including $Securitized\ Assets$, $Bank\ size$, $Capital\ Ratio$, $Bank\ ROA$, $Charge\text{-}off$, and $C\&ILoans$ are controlled for. Bank characteristics are weighted by the prevailing facility amount if a firm borrows from multiple lenders in a given year. Firm fixed effects and industry-year fixed effects are included. Clustered standard errors at the industry level are reported in the brackets. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

	Panel A: High Market Discipline				
	$R\&D_t$	$Patent_{t+1}$	$Patent_{t+2}$	$Citations_{t+1}$	$Citations_{t+2}$
Post×Treat	-0.2524*	-0.1683**	-0.1659**	-0.0612***	-0.0378**
	[0.1261]	[0.0642]	[0.0711]	[0.0189]	[0.0175]
Firm Characteristics	Yes	Yes	Yes	Yes	Yes
Bank Characteristics	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Industry-Year FE	Yes	Yes	Yes	Yes	Yes
Observations	1,177	1,014	846	1,014	846
Adjusted R^2	0.9319	0.9348	0.9343	0.3042	0.2436

	Panel B: Low Market Discipline				
	$R\&D_t$	$Patent_{t+1}$	$Patent_{t+2}$	$Citations_{t+1}$	$Citations_{t+2}$
Post×Treat	-0.3178	-0.1352***	-0.1166**	-0.0347	-0.0229
	[0.2640]	[0.0427]	[0.0468]	[0.0233]	[0.0286]
Firm Characteristics	Yes	Yes	Yes	Yes	Yes
Bank Characteristics	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Industry-Year FE	Yes	Yes	Yes	Yes	Yes
Observations	1,084	934	781	934	781
Adjusted R^2	0.8614	0.9580	0.9618	0.3384	0.2718

Table 8:
External Finance Dependence

This table presents the effects of lenders' consolidation of securitization entities on innovation of in high versus low external finance dependent (EFD) industries. Firms in industries with EFD value above the median are considered to depend more external finance. The dependent variables are *R&D*, *Patent*, and *Citations*. The dependent variables are *R&D*, *Patent*, and *Citations*. *Post* is an indicator equal to one for the post-regulation period and zero otherwise. *Treat* is an indicator equal to one if the firm borrows from a lender that consolidates securitization entities under the new regulation and zero otherwise. A set of firm characteristics, including $ln(Sales)$, M/B, CF, PPE, *S.Growth*, *Leverage*, and *Cash*, and bank characteristics, including *Securitized Assets*, *Bank size*, *Capital Ratio*, *Bank ROA*, $Charge\text{-}off$, and *C&ILoans* are controlled for. Bank characteristics are weighted by the prevailing facility amount if a firm borrows from multiple lenders in a given year. Firm fixed effects and industry-year fixed effects are included. Clustered standard errors at the industry level are reported in the brackets. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

	Panel A: High External Finance Dependence				
	$R\&D_t$	$Patent_{t+1}$	$Patent_{t+2}$	$Citations_{t+1}$	$Citations_{t+2}$
Post×Treat	-0.4439*	-0.1832***	-0.1610***	-0.0445*	-0.0137
	[0.2306]	[0.0503]	[0.0468]	[0.0232]	[0.0233]
Firm Characteristics	Yes	Yes	Yes	Yes	Yes
Bank Characteristics	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Industry-Year FE	Yes	Yes	Yes	Yes	Yes
Observations	1,396	1,201	995	1,201	995
Adjusted R^2	0.8780	0.9607	0.9626	0.4000	0.3389

	Panel B: Low External Finance Dependence				
	$R\&D_t$	$Patent_{t+1}$	$Patent_{t+2}$	$Citations_{t+1}$	$Citations_{t+2}$
Post×Treat	-0.1725**	-0.0675	0.0245	-0.0466	-0.0143
	[0.0801]	[0.0709]	[0.0775]	[0.0297]	[0.0375]
Firm Characteristics	Yes	Yes	Yes	Yes	Yes
Bank Characteristics	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Industry-Year FE	Yes	Yes	Yes	Yes	Yes
Observations	824	702	569	702	569
Adjusted R^2	0.8785	0.8571	0.8671	0.1436	0.0550

Table 9: Consolidation and Bank Lending

This table reports the effects of lenders' consolidation of securitization entities on loans to treatment and control firms. *Spread* is the natural logarithm of all-in-drawn spreads of loans. *Amount* is the natural logarithm of facility amounts. *Post* is an indicator equal to one for the post-regulation period and zero otherwise. $Treat$ is an indicator equal to one for loans of lenders that consolidate securitization entities under the new regulation and zero otherwise. A set of firm characteristics, including $ln(Sales)$, M/B, CF, PPE, $S.Growth$, $Leverage$, and $Cash$, and bank characteristics, including $Securitized\ Assets$, $Bank\ size$, $Capital\ Ratio$, $Bank\ ROA$, $Charge\text{-}off$, and $C\&I Loans$ are controlled for. Firm fixed effects, industry-year fixed effects, bank fixed effects, and loan type fixed effects are included. Clustered standard errors at the industry level are reported in the brackets. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

	Spread	Amount
Post×Treat	0.3354***	-0.6080***
	[0.0993]	[0.2220]
Firm Characteristics	Yes	Yes
Bank Characteristics	Yes	Yes
Firm FE	Yes	Yes
Industry-Year FE	Yes	Yes
Bank FE	Yes	Yes
Loan Type FE	Yes	Yes
Observations	1036	1112
Adjusted R^2	0.864	0.5739

Table 10: Matched Banks

This table reports the effects of lenders' consolidation of securitization entities on bank loans using a matched sample of affected and control banks. Banks are matched using propensity scores based on averages of *Securitized Assets*, *Bank size*, *Capital Ratio*, *Bank ROA*, *Charge-off*, and *C&I Loans* prior to the regulation (2007-2009). Panel A reports bank characteristics for the matched sample of treated and control banks. *Diff* is differences in bank characteristics of treated and control banks. *t-Stat* is t-statistics of t-test. Panel B reports the impacts of banks' consolidation of securitized assets on their lending. *Spread* is the natural logarithm of all-in-drawn spreads of loans. *Amount* is the natural logarithm of facility amounts. *Post* is an indicator equal to one for the post-regulation period and zero otherwise. *Treat* is an indicator equal to one for loans of lenders that consolidate securitization entities under the new regulation and zero otherwise. A set of bank characteristics, including *Securitized Assets*, *Bank size*, *Capital Ratio*, *Bank ROA*, *Charge-off*, and *C&I Loans* are controlled for. Firm fixed effects, industry-year fixed effects, bank fixed effects, and loan type fixed effects are included. Clustered standard errors at the industry level are reported in the brackets. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

Panel A: Summary Statistics of Matched Banks						
	Bank Size	Bank ROA	Capital Ratio	Charage-Off	Securitization	C&I Loans
Affected Bank	15.50	0.40	11.12	0.80	1.04	12.31
Control Bank	15.82	0.27	10.73	0.68	1.63	10.91
Diff	0.32	-0.12	-0.39	-0.12	0.59	-1.40
t-Stat	1.03	-0.73	-0.58	-1.16	1.03	-1.31

Panel B: Lending of Matched Banks		
	Spread	Amount
Post×Treat	0.1728*	-0.3051***
	[0.0978]	[0.1035]
Firm Characteristics	Yes	Yes
Bank Characteristics	Yes	Yes
Firm FE	Yes	Yes
Industry-Year FE	Yes	Yes
Bank FE	Yes	Yes
Loan Type FE	Yes	Yes
Observations	1200	1264
Adjusted R^2	0.9468	0.8265

Table 11:
Concurrent Shocks

This table presents the effects of lenders' consolidation of securitization entities on firm innovation and bank lending controlling for concurrent events. Columns (1)–(3) and Columns (4)–(5) of all panels report the estimation results for firm innovation and bank lending, respectively. *Post* is an indicator equal to one for the post-regulation period and zero otherwise. In Panel A, we construct the deposit-weighted exposure index for each bank using changes in state-level HPI with the percentage of deposits in each state as weights. For lending analyses, *Low Exposure* is equal to one for loans of banks with the deposit-weighted exposure index below the median value, and zero otherwise. For innovation analyses, the exposure index is averaged to the firm-year level weighted by the prevailing loan amounts borrowed from each bank; *Low Exposure* is equal to one for firms with the average index below the median value, and zero otherwise. In Panel B, for lending analyses, *RegPressure* is equal to one for loans of banks with MSRs relative to tier 1 capital above the 10% threshold, and zero otherwise. For innovation analyses, *RegPressure* is equal to one for firms that borrow from banks with MSRs relative to tier 1 capital above the 10% threshold in the year, and zero otherwise. In Panel C, for lending analyses, we compute the sum of market-adjusted three-day cumulative abnormal returns centered around the 17 key events leading up to adoption of the Dodd-Frank Act for each bank and assigned the value to its loans ($CAR\ Dodd\text{-}Frank$). For innovation analyses, the value is averaged to the firm-year level weighted by the prevailing loan amounts borrowed from each bank. In Panel D, for lending analyses *StressTest* is equal to one for loans of banks subject to the stress tests, and zero otherwise. For innovation analyses, *StressTest* is equal to one for firms that borrow from banks subject to the stress tests in the year, and zero otherwise. In Panel E, for lending analyses, $TARP$ is equal to one for loans of banks that participate in the TARP program, and zero otherwise. For innovation analyses, $TARP$ is equal to one for firms that borrow from banks participating in the TARP program in the year, and zero otherwise. A set of firm characteristics, including $ln(Sales)$, M/B, CF, PPE, *S.Growth*, *Leverage*, and *Cash*, and bank characteristics, including *Securitized Assets*, *Bank size*, *Capital Ratio*, *Bank ROA*, $Charge\text{-}off$, and $C\&ILoans$ are controlled for. For lending analyses, we include firm fixed effects, industry-year fixed effects, bank fixed effects, and loan type fixed effects. For innovation analyses, we include firm fixed effects and industry-year fixed effects. Clustered standard errors at the industry level are reported in the brackets. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

	Panel A: Exposure to Real Estate Prices				
	(1)	(2)	(3)	(4)	(5)
	$R\&D_t$	$Patent_{t+1}$	$Citations_{t+1}$	Spread	Amount
Post×Treat	-0.3145**	-0.1604***	-0.1330***	0.3356***	-0.6515***
	[0.1482]	[0.0436]	[0.0459]	[0.1200]	[0.1980]
Low Exposure	-0.1818*	0.0227	0.0397		
	[0.1011]	[0.0346]	[0.0490]		
Low Exposure×Post	0.2582	0.0777	-0.0597	-0.05	0.1596
	[0.1657]	[0.0675]	[0.0936]	[0.0956]	[0.2110]
Firm Characteristics	Yes	Yes	Yes	Yes	Yes
Bank Characteristics	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Industry-Year FE	Yes	Yes	Yes	Yes	Yes
Bank FE	No	No	No	Yes	Yes
Loan Type FE	No	No	No	Yes	Yes
Observations	2,294	1,974	1,648	1,036	1,112
Adjusted R^2	0.8836	0.9505	0.9525	0.8634	0.5735

	Panel B: Regulatory Pressure under Proposed Basel III				
	(1)	(2)	(3)	(4)	(5)
	$R\&D_t$	$Patent_{t+1}$	$Citations_{t+1}$	Spread	Amount
Post×Treat	-0.2742*	-0.1544***	-0.1418***	0.2509**	-0.6548**
	[0.1508]	[0.0417]	[0.0436]	[0.1247]	[0.2711]
RegPressure	0.4737	0.0417	0.0415		
	[0.3182]	[0.0669]	[0.0469]		
RegPressure×Post	-0.1614	0.0014	0.0123	0.1133	0.1036
	[0.1258]	[0.0448]	[0.0416]	[0.1199]	[0.1915]
Firm Characteristics	Yes	Yes	Yes	Yes	Yes
Bank Characteristics	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Industry-Year FE	Yes	Yes	Yes	Yes	Yes
Bank FE	No	No	No	Yes	Yes
Loan Type FE	No	No	No	Yes	Yes
Observations	2,294	1,974	1,648	1,036	1,112
Adjusted R^2	0.8839	0.9504	0.9525	0.8630	0.5730

	Panel C: Dodd-Frank Act				
	(1)	(2)	(3)	(4)	(5)
	$R\&D_t$	$Patent_{t+1}$	$Citations_{t+1}$	Spread	Amount
Post×Treat	-0.2540*	-0.1466***	-0.0475***	0.2795***	-0.5666**
	[0.1527]	[0.0422]	[0.0177]	[0.0900]	[0.2196]
CAR Dodd-Frank	-0.2930*	-0.0641	-0.0564**		
	[0.1626]	[0.0597]	[0.0226]		
CAR Dodd-Frank×Post	0.3533**	0.0167	0.0291	-0.8215**	0.9528***
	[0.1642]	[0.0661]	[0.0279]	[0.3955]	[0.3348]
Firm Characteristics	Yes	Yes	Yes	Yes	Yes
Bank Characteristics	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Industry-Year FE	Yes	Yes	Yes	Yes	Yes
Bank FE	No	No	No	Yes	Yes
Loan Type FE	No	No	No	Yes	Yes
Observations	2,294	1,974	1,648	1,036	1,112
Adjusted R^2	0.8841	0.9505	0.9525	0.8658	0.5743

	Panel D: Stress Test				
	(1)	(2)	(3)	(4)	(5)
	$R\&D_t$	$Patent_{t+1}$	$Citations_{t+1}$	Spread	Amount
Post×Treat	-0.2878*	-0.1607***	-0.1433***	0.3323***	-0.6038*
	[0.1654]	[0.0426]	[0.0441]	[0.1208]	[0.3493]
StressTest	-0.0187	-0.0564	-0.0156	0.3237	0.0839
	[0.1244]	[0.0389]	[0.0525]	[0.2103]	[0.3081]
StressTest×Post	0.0551	0.0837	0.0373	-0.1664	-0.1153
	[0.2226]	[0.0592]	[0.0690]	[0.1453]	[0.3255]
Firm Characteristics	Yes	Yes	Yes	Yes	Yes
Bank Characteristics	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Industry-Year FE	Yes	Yes	Yes	Yes	Yes
Bank FE	No	No	No	Yes	Yes
Loan Type FE	No	No	No	Yes	Yes
Observations	2,294	1,974	1,648	1,032	1,110
Adjusted R^2	0.8835	0.9505	0.9525	0.8663	0.5699

	Panel E: TARP				
	(1)	(2)	(3)	(4)	(5)
	$R\&D_t$	$Patent_{t+1}$	$Citations_{t+1}$	Spread	Amount
Post×Treat	-0.2855*	-0.1581***	-0.1420***	0.5122***	-0.5029**
	[0.1588]	[0.0408]	[0.0437]	[0.1113]	[0.1988]
TARP	0.0203	-0.0349	-0.0138	0.1089	0.0796
	[0.0930]	[0.0431]	[0.0351]	[0.1294]	[0.2846]
TARP×Post	-0.1036	0.0342	0.0163	-0.0352	-0.1414
	[0.1197]	[0.0519]	[0.0565]	[0.1564]	[0.3130]
Firm Characteristics	Yes	Yes	Yes	Yes	Yes
Bank Characteristics	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Industry-Year FE	Yes	Yes	Yes	Yes	Yes
Bank FE	No	No	No	Yes	Yes
Loan Type FE	No	No	No	Yes	Yes
Observations	2,294	1,974	1,648	1,032	1,107
Adjusted R^2	0.8835	0.9505	0.9524	0.8659	0.5666