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

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Abstract

We investigate how the financing of innovation is influenced by off-balance-sheet treatment of securitization. Exploiting a recent mandate that removes this treatment for some securitizations, we find a reduction in innovation for firms that borrow from affected banks. The reduction is concentrated among firms whose lenders experience more downward pressure on regulatory capital ratios and greater market discipline, and firms more dependent on external finance. We further find that affected banks raise loan spreads and cut loan amounts after the mandate. Various robustness analyses support the view that off-balance-sheet treatment of securitization facilitates innovation by lowering firms' borrowing costs and increasing funds available.

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

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

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1 Introduction

A key driver of firms' competitive advantages and overall economic growth is technological innovation (King and Levine, 1993; Kogan et al., 2016). Funding innovation activities however is often plagued by limited capital supply (Holmstrom, 1989; Hall and Lerner, 2010). Prior literature provides evidence on how innovation is affected by various aspects of conventional financial systems, such as venture capital (Kortum and Lerner, 2000; Chemmanur et al., 2014), development of equity markets (Brown et al., 2013; Hsu et al., 2014), and deregulation in banking sectors (Amore et al., 2013; Chava et al., 2013; Cornaggia et al., 2015; Hombert and Matray, 2016). Relatively less attention has been devoted to understanding the potential effects of securitization.

Securitization represents financial intermediation that, unlike traditional commercial banking, mostly does not take place on banks' balance sheets and is subject to lesser or no safety and soundness regulation (Cetorelli et al., 2012). During securitization, banks or financial services companies transfer claims on financial assets to broad investor classes (e.g., money market funds) through a wide range of structured finance products such as asset-backed securities (ABS), asset-backed commercial papers (ABCP), and collateralized loan obligations (CLOs). According to the Flow of Funds Accounts of the United States, $3.5 trillion of financial assets were securitized as of 2006Q4 (Table L.126), in comparison to $6.1 trillion of total loans held on balance sheets of commercial banks (Table L.109). Understanding the impact of securitization on technological innovation is particularly important, as evidenced by numerous deliberations of policy makers on how to appropriately regulate this nascent financial sector to encourage healthy economic

risk-taking while maintaining financial stability (Federal Reserve Board, 2009; Murphy, 2013; IMF, 2014; Financial Stability Board, 2015).

Much of the existing work on securitization focuses on consequences of economic risk transfer in the originate-to-distribute model. The consequences include reduced incentives to screen and monitor borrowers (Mian and Sufi, 2009; Keys et al., 2010; Benmelech et al., 2012; Wang and Xia, 2014), cheaper capital due to risk sharing and bankruptcy remoteness of securitized assets (Berndt and Gupta, 2009; Ayotte and Gaon, 2011; Nadauld and Weisbach, 2012; Lemmon et al., 2014), and attendant security design choices (Drucker and Puri, 2009; Benmelech and Dlugosz, 2009; Begley and Purnanandam, 2017). In contrast to these studies, we examine the off-balance-sheet treatment awarded by accounting standards and regulatory capital rules for securitization (hereafter, "off-balance-sheet treatment").[1] This treatment played a crucial role in fueling the rapid growth of shadow banking systems and the ensuing financial crisis (Shivdasani and Wang, 2011; Acharya et al., 2013). We explore influences of this treatment on banks' funding of firm innovation.[2]

The off-balance-sheet status of securitization enables banks to circumvent capital requirements and increase effective leverage (Calomiris and Mason, 2004). Consequently, banks have more funds available to lend. 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

[1]The off-balance-sheet treatment in regulatory capital rules refers to partly bank regulator's passive adoption of Generally Accepted Accounting Principles and partly active exclusion of on-balance-sheet ABCP conduits during assessment of regulatory adequacy (Acharya et al., 2013).

[2]Pozsar et al. (2013) identify three non-mutually exclusive subgroups of the shadow banking system: 1) the government-sponsored shadow banking subsystem that purchases and securitizes residential mortgages, 2) the "internal' shadow banking subsystem developed and operated by banks through off-balance-sheet securitization and asset management techniques, and 3) the "external" shadow banking subsystem consisting of broker-dealers and other independent nonbank specialist intermediaries. We focus on largely the "internal' subsystem since it resides within banks that also fund innovation activities through commercial lending.

ratio of 10%). By securitizing $20 million of existing loans, the bank effectively refinances these loans using $20 million of ABS, 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 lent and have to be paid off to meet the target ratio. Figure 1 illustrates the three aforementioned cases. In addition to the regulatory effect, the treatment could reduce market discipline to the extent that market participants view off-balance-sheet items less risky (Barth et al., 2012; Callahan et al., 2012; Bonsall et al., 2017). It is important to note that our investigation is not confined to securitization of loans extended to innovative firms (through CLOs). Rather, we are interested in all securitized assets of which the off-balance-sheet status influences banks' credit supply.

It is unclear *a priori* whether off-balance-sheet treatment of securitization fosters or impedes firm innovation. On the one hand, the increased credit availability can translate into more and cheaper commercial lending that alleviates borrowers' financial constraints and promotes innovation (Loutskina, 2011; Kerr and Nanda, 2015). Loans may be used to finance innovation projects directly (Mann, 2016; Chava et al., 2016) or indirectly, whereby financing traditional investment with bank loans, firms can divert more internal resources to innovation (Amore et al., 2013).

On the other hand, prior research finds that credit markets exert no or even negative effects on innovation. Because of innovation projects' unstable internal cash flows to service debt, right-skewed returns that cannot be reaped by creditors in an asymmetric

payoff structure, and limited collateral value, creditors may impose stringent terms and exhibit little tolerance during renegotiation for early failure which could discourage research and development (R&D) activities (Beck and Levine, 2002; Hall and Lerner, 2010; Brown et al., 2013; Hsu et al., 2014). To the extent that extra bank credit stemming from off-balance-sheet treatment of securitization exacerbates such discouraging effects, there could be a negative relationship between off-balance-sheet treatment and innovation. Thus, how this accounting and regulatory treatment of securitization influences firms' innovation is ultimately an empirical question.

We exploit a recent regulation that brought some securitizations onto banks' balance sheets. The Financial Accounting Standard 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 consolidated $765 billion of securitized assets, about 80% of those assets held by credit card master trusts and 10% held by ABCP conduits (Dou et al., 2017).[3] Bank regulators shortly decided to include the consolidated assets and associated loan loss reserves during 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 brought down newly consolidating banks' tier 1 leverage capital ratio by about one percentage point, which is considerable in comparison to Berger et al.

[3]The vast majority of residential mortgage securitizations and 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).

[4]Regulators included consolidated securitization assets and associated loan loss reserves during leverage ratio calculations starting in 2010Q1 and risk-based capital ratio calculations with an optional two-quarter delay and two-quarter phase-in period. Regulators also eliminated their prior 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.

(2008, 137)'s estimate that banks on average manage that ratio upwards by 46 basis points.

Examining this new regulation is particularly advantageous to answer our research question. First, the regulation takes away off-balance-sheet treatment but not the originate-to-distribute model, enabling us to isolate the impacts of the former. In contrast, it is difficult to do so prior to this regulatory change as the favorable treatment goes hand-in-hand with economic risk transfer (Wang and Xia, 2014). Second, the mandate affects only consolidating banks, but does not influence banks whose securitized assets remain entirely unconsolidated. This allows us to compare changes around the mandate in innovation of firms whose lenders are affected versus otherwise similar firms that borrow from unaffected securitizing banks. It is worth noting that although relative to unaffected banks, consolidating banks securitize more credit card loans, they do not necessarily suffer more from liquidity shocks during the 2007 financial crisis. This is because other ABS (e.g., home mortgages) declines more than credit card securitization during and after the crisis.[5] We nevertheless control for total securitized assets of lenders as a proxy for exposure to securitization markets throughout analysis.

We employ a difference-in-differences approach to a matched sample of treatment and control firms. The sample period spans 2007-2013, including three years before (as the pre-period) and four years since (as the post-period) adoption of the mandate. The treatment group consists of firms that borrow from affected banks both before and after the

[5]The Flow of Funds Accounts of the United States reports that total securitized home mortgages decreased from $2.2 trillion at the beginning of 2007 to $1.6 trillion at the end of 2009, in contrast to total securitized consumer credit from $617 billion to $572 billion over the same period (http://www.federalreserve.gov/releases/z1/).

mandate. The control group consists of matched firms that have no lending relationship with affected bank but are observably similar in their characteristics and lenders' total securitized assets. We observe that those variables are similar between treatment and control firms, suggesting a comparable sample. The difference-in-differences approach removes any permanent differences between the treatment and control firms and any common trend affecting both groups.

In the primary analysis, we find a significant decrease in R&D and patent production for treatment firms following the mandate, in comparison to control firms. The ratio of R&D to total assets decline about 16% relative to the mean and the number of patents (citations per patent) drops by about 14%-15% (3%-5%), which are economically significant. Further, the decrease in innovation holds more strongly for firms whose lenders experience larger downward impacts on tier 1 capital ratios and greater market discipline as proxied by higher uninsured deposits and for firms in more external finance dependent industries. The three cross-sectional results bolster our confidence in interpreting the main effects, as it is more difficult to conceive an alternative story that explains our primary and interaction results simultaneously (Rajan and Zingales, 1998).

We assess to what extent our finding is attributable to the regulation as opposed to other economic forces such as preexisting trends or differential exposure to the financial crisis. First, we examine the dynamic effects of this mandate by tracing the timing of the reduction in innovation. We find that the reduction does not appear prior to the mandate, manifests after the adoption year, and becomes stronger in later years, suggesting no preexisting divergent trends in firm innovation. 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 treatment and control firms. Thus, firms' differential exposure to the financial crisis unlikely explain our results.

To shed light on mechanisms that underlie the reduction in firm innovation, we investigate changes in contractual terms of loans extended to treatment and control firms. Theoretical and empirical studies demonstrate that an incumbent bank's private information about a borrower's creditworthiness 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). If the mandate that removes the off-balance-sheet status of securitization hinders firm innovation through decreased credit supply, we would expect an increase in loan spreads and a decrease in loan amounts. This prediction is further supported by banking organizations' comment letters on this regulation. For example, American Securitization Forum warned that the new rules threatened to "decrease the availability and/or increase the price of credit to consumers and businesses."[6]

Consistent with this prediction, we find that loans of affected banks experience an increase in spreads and a decrease in amounts, in comparison to loans of unaffected banks following the regulation. The results are robust to using a sample of matched banks, in which bank characteristics are statistically indistinguishable. Collectively, the findings support the notion that off-balance-sheet treatment of banks' securitization facilitates firms' innovation activities by lowering their borrowing costs and increasing borrowing amounts.

[6]https://www.fdic.gov/regulations/laws/federal/2009/09c24ad48.pdf

In the final set of analyses, we consider five potential confounding events that may have coincided with the implementation of the new regulation. Following 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 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 overlooked financial sector in the innovation literature. Second, by exploiting a recent accounting and regulatory change, we are able to isolate implications of off-balance-sheet treatment, thus complementing the securitization literature that mostly focuses on the economic-risk-transfer aspect.

Third, our evidence does not imply that regulators should grant more bank assets off-balance-sheet treatment in order to promote innovation and social welfare. Numerous studies show that the 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). Since the financial crisis, regulators, standard setters, investors, and many others have called for more regulatory efforts in harnessing risk in securitization. Our results suggest that with respect to off-balance-sheet treatment of securitization,

there is a trade-off: although the treatment may cause activities jeopardizing financial stability, policies aimed at removing the treatment could have unintended consequences on the economy by inhibiting innovation activities and thereby long-term economic growth (Kogan et al., 2016).

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 broad investor classes (e.g., money market funds). The process typically involves the transfer of financial assets to a legally separate securitization entity (e.g., special purpose entity, or 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 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

[7]The recourse and enhancement suggest that some risk 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.

under sale accounting. Non-QSPEs, such as asset-backed commercial paper (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 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 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 drew criticism as banks incurred considerable losses from their securitizations during the 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 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 those loans are deemed primary beneficiaries and have to consolidate them under SFAS No. 167 (Tian and Zhang 2016). Previous restructuring arrangements by sponsor banks to circumvent FIN 46 (R) no longer work under SFAS No. 167, and they need to consolidate ABCP conduits. Collectively, the new standards bring previously off-balance-sheet securitized assets worth 5.46% of banks' total assets onto their financial statements.[8]

Shortly after the new accounting standards, in January 2010, bank regulators issued a final rule that includes consolidated assets during regulatory capital calculations. Consolidating banks are required to recognize loss reserves for loans of consolidated securitization entities, which reduce the numerator of capital ratios (i.e., tier 1 capital), and to include net assets of the entities in total assets, which increase the denominator (i.e., total or risk-weighted assets). Together, the consolidation imposes sizable downward pressure on regulatory capital ratios. 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

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

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 and Rosengren, 1997; Berger et al., 2008; Adrian and Shin, 2011; Kashyap et al., 2010). 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.[9] 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 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.

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 (Brown et al., 2009, 2013; Benfratello et al., 2008; 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 senti-

[9] 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 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 theoretical and empirical banking research on impacts of capital requirements on bank operations.

ment (Dang and Xu, 2017), analyst coverage (He and Tian, 2013), institutional ownership (Aghion et al., 2013), hedge fund activism (Brav et al., 2016), 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 those aspects influence innovation through various channels, altering 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 spurs innovation by lowering borrowing costs and increasing borrowing amounts of innovative firms.

Second, the recent financial crisis has 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 (Mian and Sufi, 2009; Downing et al., 2009; Keys et al., 2010; Benmelech et al., 2012; Wang and Xia, 2014; Berndt and Gupta, 2009; Ayotte and Gaon, 2011; Gande and Saunders, 2012; Nadauld and Weisbach, 2012; Lemmon et al., 2014; Drucker and Puri, 2009; Benmelech and Dlugosz, 2009; 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 ones with less capital, to sponsor ABCP conduits and such securitization does not transfer risk as sponsor banks absorb all losses in the early phase of the financial crisis. While the two studies focus on banks, we extend this line of inquiry to borrowing firms' innovation, a vital piece for long-run economic growth.

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 them explores implications of this regulation on an important sector, corporate loans and their pricing, which we address in this paper. Our results of heightened loan spreads and reduced loan amounts and their findings of reduced lending in credit cards, mortgages, and small business loans support collectively the notion that removing off-balance-sheet treatment curtail overall credit supply. Using detailed data on lending relationships, we are able to identify affected borrowers and examine how their innovation is influenced by the new regulation. The examination of consequences to borrowing firms complements extant research and inform evaluation of the regulation.

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 during 2007-2016 and extract information about assignee names, patent numbers, application dates, grant dates, cited patents, and citing patents from the documents. The patent data are then matched with firm financial data 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 Kogan et al. (2016) patent data, covering the period 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. 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.[10] We

[10]We identify the lead agent following a procedure similar to Chakraborty et al. (2016). The lender with

match borrowers with their financial data using Chava and Roberts (2008) DealScan-Compustat link table. We link lenders to financial information of their parent bank holding companies (BHC) 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 maintains throughout the entire life cycle 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-year level weighted by the prevailing loan amounts borrowed from each bank.[11] There are

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".

[11]For example, Firm A borrowed a loan of $5 million from Bank A in 2007 with five-year maturity. This firm then borrowed another loan of $10 million from Bank B in 2009 with three year maturity. We first compile a sample of eight firm-bank-year observations and then collapse it to a sample of five

11.53% of firms borrowing from multiple banks in a year. We keep firms that borrow at least one loan before and after the new regulation. We identify treatment firms as those with loans from lenders that consolidate off-balance-sheet securitization entities under the new regulation and control firms as those borrowing from unaffected lenders. Since the interest is about impacts of bank activities on firm innovation, we restrict treatment firms to those borrowing from the same affected lender before and after the regulation.

To ease the concern that firms in treatment and control groups may be incomparable, we match treatment and control 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 investment, and lenders' total securitized assets over the period before the regulation (2007-2009) as independent variables.[12] The variable definitions are available in the Appendix. We then use 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 effects of the new regulation on firm innovation.

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

firm-year observations using Bank A's characteristics in 2007-2008 and weighted averages of Bank A's and B's characteristics in 2009-2011 with the weight of $1:2$.

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

between treatment and control firms, except for $ln(Sales)$. To disqualify the possibility that differences in these characteristics rather than the regulation explain the differences in innovation across treatment and control firms, we control for these variables throughout our analyses. The summary statistics of characteristic variables of the pooled matched sample are reported in Table 1 Panel B. 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 regulation. In the bottom two rows, Table 1 Panel B presents loan spreads and facility amounts of the 1,509 loans in the sample.

3.3 Innovation Measures

We use R&D spending, 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 ends in 2013, patent data are collected up to 2016 because the average time lag between the patent application date and grant date is 2 to 3 years (Hall et al., 2001). We do not count patent applications that are not granted up to 2016. 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 counts by the average citation counts 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 shows 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:

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

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, the natural logarithm of one plus the number of patents produced by firm i in year $t+1$ to $t+2$, and the natural logarithm of one plus the number of citations per patent by firm i in year $t+1$ to $t+2$. $Treat$ is an indicator variable that equals one if the firm borrows from a lender 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 characteristic variable including $ln(Sales)$, M/B, CF, PPE, $S.Growth$, $Leverage$, and $Cash$.[13] The vector Z is a set of bank characteristic variables including securitized assets, bank size, capital ratios, bank ROA, charge-offs and C&I loans, aggregated to the firm-year level as discussed above.

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

We include them to account for differences between consolidating and non-consolidating banks.

Firm fixed effects, η_i are included to control for time-invariant differences between treatment and control firms. Firms in the same industry may experience common demand and technology shocks. To control for the 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 firm innovation activities are negatively affected by their lenders' consolidation of securitization entities. The negative estimates of β_1 indicate that firms borrowing from lenders that consolidate previously off-balance-sheet securitization spend less on R&D, produce lower quantity and quality of patents after the new regulation. The deterioration is also economically significant. The R&D of treatment firms decreases 16% ($= -0.2815/1.76$) relative to the mean and the number of patents (citations per patent) drops ranging from 14% to 15% (3% to 5%).[14] M/B and lenders' securitized assets are positively associated with R&D.

4.2 Dynamics of Innovation

The implementation of the new regulation represents a shock to treatment firms' financing of innovation and we estimate the impact on their innovation using a difference-in-differences design. A concern may arise that the result simply captures preexisting

[14]Lemmon et al. (2014) reports 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.

divergent trends in innovation and has nothing to do with the regulation. Alternatively, whether a lender consolidates 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 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 years around 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 $Pre \times Treat$, indicating whether there is any relation between firms' innovation and lenders' consolidation of securitization entities before the new rules. We are also interested in coefficients on interactions between $Treat$ and other indicators, which tell the timing of the reduction in innovation.

In Table 4, we report the results controlling 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 regulation. Thus, there is no evidence for preexisting divergent trends or reverse causality. For $R\&D$ ($Patent$ and $Citations$), we observe 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 explained by the 2007-2008 financial crisis. The crisis may influence consolidating banks more adversely because they engaged in more securitizations than non-consolidating ones did, hampering their credit supply even in the absence of the new regulation. Continuation of the differential impacts after 2010 might explain out findings. This concern is alleviated in several ways. First, our sample does not contain pre-crisis years. Since the new standards are effective at the beginning of 2010 when the economy is recovering, it should be less likely to find a negative impact on firms' innovation activities. Second, we include lenders' total securitized assets as a matching variable when performing the propensity score matching, and control for this variable during 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 crisis because the meltdown of home mortgage securitization is more severe than that of credit card securitization. The Flow of Funds Accounts of the United States reports that total securitized home mortgages decreased from $2.2 trillion at the beginning of 2007 to $1.6 trillion at the end of 2009, in comparison to total securitized consumer credit from $617 billion to $572 billion over the same period.

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 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 lenders and thus exacerbating borrowers' financing difficulties. In the next three subsections, we explore cross-sectional variations in factors that underlie this interpretation: downward pressure on lenders' capital ratios due to consolidation, the strength of market discipline over banks, and borrowers' dependence on external finance.

5.1 Downward Pressure on Lenders' 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 loan loss reserves of 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 lenders facing above median downward pressure due to consolidation and their matched control firms are classified into the high downward pressure subsample, and those otherwise into the low downward pressure subsample.

We estimate the baseline model 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 innovation activities of firms that borrow from banks with a larger impact of consolidation on capital ratios are affected more.

5.2 The Strength of Market Discipline

To the extent that market participants view on-balance-sheet assets riskier than off-balance-sheet ones (Barth et al., 2012; Callahan et al., 2012; Bonsall et al., 2017), consolidation of securitization entities likely increases market discipline over banks (e.g., by increasing the cost of capital), pressuring banks to cut 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).[15] 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 lenders with above median uninsured deposits and their matched control firms are classified into the high market discipline subsample, and those otherwise into the low market discipline subsample.

We estimate the baseline model separately for the two subsamples and report the estimation 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 coefficients in Panel A is much larger than that in Panel B, suggesting that 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 innovative activities, firms dependent more 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 by 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

[15] 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.

in a year is computed as the fraction of investments not financed through internal cash flow.[16] Industries with external finance dependence above (below) the median value are considered as high (low) external finance dependence industries.

As shown in Table 8, for firms with 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 for firms with low dependence on external finance. Comparing the coefficients on the interaction term across the two subsamples, banks' consolidation of securitization has a much stronger impact on innovation of firms with a higher need for external capital.

6 Financing Mechanisms

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

6.1 Bank Lending

If the decline in firm innovation is driven by reduced credit supply of banks that consolidate previously off-balance-sheet securitization entities, we expect an increase in loan pricing and a decrease in the size of loans. 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 *all-in-drawn-*

[16] 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.

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 *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).[17] 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, suggesting that after the regulation, consolidating banks charge 39.8% ($= e^{0.3354} - 1$) higher loan spreads and extend 54% ($= e^{-0.6080} - 1$) smaller loans, in comparison to non-consolidating banks. Together, the results support the notion that the new regulation is associated with a sizable decline in credit supply as the financing mechanisms, whereby removing off-balance-sheet treatment of securitization decreases firm innovation.

6.2 Matched Banks

One possibility is that banks affected by the regulation might be different from banks unaffected, despite a battery of bank characteristics and bank fixed effects as controls in our tests. To further ease the concern, we 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 the effective year of the new rules. The descriptive statistics for the matched 82 pairs of banks are reported in Table 10 Panel A. The matched banks have

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

similar characteristics both before and after the regulation.

We then pool all loans originated by these banks via DealScan. Using this sample of loans from matched banks, we re-estimate the specifications in Table 9.[18]. As shown in Table 10, loans of affected banks exhibit higher spreads and lower amounts than those of matched control banks from the pre-regulation to the post-regulation periods. Thus, our results are unlikely explained by the differences between affected and unaffected banks.

7 Concurrent Events

During our sample periods of 2007-2013, real estate prices plunged initially and recovered slowly in later years. 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 test the resilience of the results to accounting for potential impacts of five concurrent events.

7.1 Real Estate Prices

The boom in real estate prices in years leading up to the 2007-2008 financial crisis and the collapse of the housing bubble during the crisis have a direct impact on mortgage markets and financial institutions. A large drop in real estate prices deteriorates banks' balance sheets and lending capacity, which could result in a reduction in loan supply. 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.

[18]To maintain a large sample, we do not restrict our sample to only Compustat firms. Consequently, we only control for firm fixed effects, but not firm characteristic variables

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 *Low Exposure* and *Low Exposure* $\times$ *Post* are controlled for. In lending analyses, *Low Exposure* is absorbed by bank fixed effects. The results suggest that the effect of removing 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 that would increase the regulatory capital requirements associated with the originate-to-distribute model. One such

provision increases the risk-weight of 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 rules 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 differential regulatory pressure faced by banks. For lending analyses, the variable $RegPressure$ is equal to one for 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 Table 11 Panel B, 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.

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 banks' investments in private equity and hedge funds to no more than 3% of the Tier 1 capital. Systemically important financial institution 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 Dodd-Frank Act also imposes more stringent regulatory capital requirements, greater transparency for derivative instruments, and more "skin in the game" for originators of asset-backed securities. See Acharya et al. (2010) for detailed discussions on implications of Dodd-Frank.

To the extent that the Dodd-Frank Act imposes regulatory burdens 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 adoption of the Dodd-Frank Act 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 as shown in Table 11 Panel C, indicating that the implementation of Dodd-Frank cannot explain our findings.

7.4 Stress Tests

The Federal Reserve 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 evolved into two related annual supervisory stress tests, the Comprehensive Capital Analysis and Review (CCAR) and the Dodd-Frank Act Stress Tests (DFAST).

The CCAR assesses capital planning and capital adequacy at large BHCs. Beginning in 2010, the first three CCARs involved BHCs with assets exceeding $100 billion at the time of 2009 SCAP. The CCAR included another 11 BHCs with assets between $50 billion and $100 billion since 2014. Under the DFAST, BHCs with assets exceeding $10 billion need to conduct annual stress tests based on economic and financial market scenarios provided by the Federal Reserve and BHCs with assets exceeding $50 billion need to conduct additional stress tests based on their own scenarios. Following the first DFAST results released in 2013, the Federal Reserve disclose the stress test results on an annual basis.

To assess whether the stress tests explain our findings, we collect stress test data from the Federal Reserve. 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 Table 11 Panel D, our results are robust to controlling for $StressTest$ and $StressTest \times Post$, suggesting that consolidating off-balance-sheet securitization 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 Wall Street Reform and

Consumer Protection Act (Dodd-Frank Act) reduced the amount authorized to $475 billion. The TARP intends 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 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 Table 11 Panel E, our results are robust to controlling for $TARP$ and its interaction with the *Post* indicator, suggesting that banks' TARP participation cannot explain our findings.

In untabulated analyses, we find that our results are robust to controlling for all 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 Conclusions

In this paper, we examine how the financing of innovation is influenced by off-balance-sheet treatment of securitization. Exploiting a recent mandate 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 is concentrated among firms whose lenders experience more downward pressure on regulatory capital ratios and greater market discipline, and firms more dependent on external finance. Further investigation indicates that these

firms experience an increase in costs of debt and a decrease in borrowing amounts. The findings are robust to various specifications and alternative measures of firm innovation. Taken together, the results support the view that off-balance-sheet securitization facilitates borrowing firms' innovation by lowering their financing costs and increasing funds available.

While many studies demonstrate dark sides of off-balance-sheet treatment of securitization, benefits from such treatment is largely overlooked. We provide evidence that removing the off-balance-sheet status of securitization 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)

$\Delta Investment$ =[Investment (capx+aqc)-lagged Investment ×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)

References

Acharya, Viral, and Stephen Ryan, 2016, Banks' financial reporting and financial system stability, *Journal of Accounting Research* 54, 277–340.

Acharya, Viral, Phillip Schnabl, and Gustavo Suarez, 2013, Securitization without risk transfer, *Journal of Financial Economics* 107, 515–536.

Acharya, Viral, and Krishnamurthy Subramanian, 2009, Bankruptcy codes and innovation, *Review of Financial Studies* 22, 4949–4988.

Acharya, Viral, Matthew Richardson Thomas Cooley, and Ingo Walter, 2010, *Regulating Wall Street: Dodd-Frank and the New Architecture of Global FInance* (John Wiley & Sons, Inc.).

Acharya, Viral, and Zhaoxia Xu, 2017, Financial dependence and innovation: The case of public versus private firms, *Journal of Financial Economics* 124, 223243.

Adrian, Tobias, and Hyun Song Shin, 2011, Financial intermediary balance sheet management, *Annual Review of Financial Economics* 3, 289–307.

Aghion, Philippe, John Van Reenen, and Luigi Zingales, 2013, Innovation and institutional ownership, *American Economic Review* 103, 227–304.

Akins, Brian, Yiwei Dou, and Jeffrey Ng, 2017, Corruption in bank lending: The role of timely loan loss recognition, *Journal of Accounting and Economics* Forthcoming.

American Bankers Association, 2009, Comment letter on proposed regulatory capital standards related to adoption of statements of financial accounting standards nos. 166 and 167.

Amore, Mario Daniele, Cedric Schneider, and Alminas Zaldokas, 2013, Credit supply and corporate innovations, *Journal of Financial Economics* 109, 835–855.

Ayotte, Kenneth, and Stav Gaon, 2011, Asset backed securities: Costs and benefits of bankruptcy remoteness, *Review of Financial Studies* 24, 1299–1335.

Barth, Mary, Gaizka Ormazabal, and Daniel J. Taylor, 2012, Asset securitizations and credit risk, *The Accounting Review* 87, 423–448.

Beck, Thorsten, and Ross Levine, 2002, Industry growth and capital allocation: does having a market- or bank-based system matter?, *Journal of Financial Economics* 64, 147–180.

Begley, Taylor, and Amiyatosh Purnanandam, 2017, Design of financial securities: Empirical evidence from private-label rmbs deals, *Review of Financial Studies* 30, 120–161.

Benfratello, Luigi, Fabio Schiantarelli, and Alessandro Sembenelli, 2008, Banks and innovation: Microeconometric evidence on italian firms, *Journal of Financial Economics* 90, 197–217.

Benmelech, Efraim, and Jennifer Dlugosz, 2009, The alchemy of cdo credit ratings, *Journal of Monetary Economics* 56, 617–634.

Benmelech, Efraim, Jennifer Dlugosz, and Victoria Ivashina, 2012, Securitization without adverse selection: The case of clos, *Journal of Financial Economics* 106, 91–113.

Bens, Daniel, and Steven Monahan, 2008, Altering investment decisions to manage financial reporting outcomes: Asset-backed commercial paper conduits and fin 46, *Journal of Accounting Research* 46, 1017–1055.

Berger, Allen, Robert DeYoung, Mark Flannery, David Lee, and Ozde Oztekin, 2008, How do large banking organizations manage their capital ratios?, *Journal of Financial Service Research* 34, 123–149.

Berger, Allen, and Rima Turk-Ariss, 2015, Do depositors discipline banks and did government actions during the recent crisis reduce this discipline? an international perspective., *Journal of Financial Services Research* 48, 103–126.

Berndt, Antje, and Anurag Gupta, 2009, Moral hazard and adverse selection in the originate-to-distribute model of bank credit, *Journal of Monetary Economics* 56, 725–743.

Bernstein, Shai, 2015, Does going public affect innovation?, *Journal of Finance* 70, 1365–1403.

Bertrand, Marianne, and Sendhil Mullainathan, 2003, Pyramids, *Journal of the European Economic Association* 1, 478–483.

Bonsall, Sam, Bozanic Zahn, Yiwei Dou, Gordon Richardson, and Dushyant Vyas, 2017, Have fas 166 and fas 167 improved the financial reporting for securitizations?, Working Paper.

Brav, Alon, Wei Jing, Song Ma, and Xuan Tian, 2016, How does hedge fund activism reshape corporate innovation, Working Paper.

Brown, James R., Steven M. Fazzari, and Bruce C. Petersen, 2009, Financing innovation and growth: Cash flow, external equity, and the 1990s R&D boom, *Journal of Finance* 64, 151–185.

Brown, James R., Gustav Martinsson, and Bruce C. Petersen, 2013, Law, stock markets, and innovation, *Journal of Finance* 68, 1517–1549.

Callahan, Carolyn, Rodney Smith, and Angela Spencer, 2012, An examination of the cost of capital implications of fin 46, *The Accounting Review* 87, 1105–1134.

Calomiris, Charles, and Joseph Mason, 2004, Credit card securitization and regulatory arbitrage, *Journal of Financial Service Research* 26, 5–27.

Cetorelli, Nicola, Benjamin H. Mandel, and Lindsay Mollineaux, 2012, The evolution of banks and financial intermediation: Framing the analysis, *FRBNY Economic Policy Review* July, 1–12.

Cetorelli, Nicola, and Stavros Peristiani, 2012, The role of banks in asset securitization, *FRBNY Economic Policy Review* July, 47–63.

Chakraborty, Indraneel, Itay Goldstein, and Andrew MacKinlay, 2016, Housing price booms and crowding-out effects in bank lending, working paper, vailable at SSRN: http://ssrn.com/abstract=2246214 or http://dx.doi.org/10.2139/ssrn.2246214.

Chava, Sudheer, Vikram Nanda, and Steven Chong Xiao, 2016, Lending to innovative firms, Working Paper.

Chava, Sudheer, Alexander Oettl, Ajay Subramanian, and Krishnamurthy Subramanian, 2013, Banking deregulation and innovation, *Journal of Financial Economics* 109, 759–774.

Chava, Sudheer, and Michael R. Roberts, 2008, How does financing impact investment? The role of debt covenants, *Journal of Finance* 63, 2085–2121.

Chemmanur, Thomas, Elena Loutskina, and Xuan Tian, 2014, Corporate venture capital, value creation, and innovation, *Review of Financial Studies* 27, 2434–2473.

Chen, Weitzu, Chi-Chun Liu, and Stephen G. Ryan, 2008, Characteristics of securitizations that determine issuers' retention of the risks of the securitized assets, *The Accounting Review* 83, 1181–1215.

Cheng, Mei, Dan Dhaliwal, and Monica Neamtiu, 2011, Asset securitization, securitization recourse, and information uncertainty, *The Accounting Review* 86, 541–568.

Cornaggia, Jess, Yifei Mao, Xuan Tian, and Brian Wolfe, 2015, Does banking competition affect innovation?, *Journal of Financial Economics* 115, 189–209.

Dang, Tri Vi, and Zhaoxia Xu, 2017, Market sentiment and innovation activities, *Journal of Financial and Quantitative Analysis* forthcoming.

Deloitte, 2014, *Securitization Accounting* (January), 9th edition.

Dou, Yiwei, 2017, The spillover effect of consolidating securitization entities on small business lending, Working paper, New York University.

Dou, Yiwei, Yanju Liu, Gordon Richardson, and Dushyant Vyas, 2014, The risk-relevance of securitizations during the recent financial crisis, *Review of Accounting Studies* 19, 839–876.

Dou, Yiwei, Stephen Ryan, and Biqin Xie, 2017, The real effects of fas 166/167 on banks' mortgage approval and sale decisions, Working paper, New York University.

Downing, Chris, Dwight Jaffee, and Nancy Wallace, 2009, Is the market for mortgage-backed securities a market for lemons?, *Review of Financial Studies* 22, 2457–2494.

Drucker, Steven, and Manju Puri, 2009, On loan sales, loan contracting, and lending relationships, *Review of Financial Studies* 22, 2835–2872.

Fang, Vivian W., Xuan Tian, and Sheri Tice, 2014, Does stock liquidity enhance or impede firm innovation?, *Journal of Finance* 69, 2085–2125.

FASB, 2009a, Statement of financial accounting standards no. 166: Accounting for transfers of financial assets, an amendment of fasb statement no. 140, Norwalk, CT: FASB.

FASB, 2009b, Statement of financial accounting standards no. 167: Amendments to fasb interpretation no. 46(r), Norwalk, CT: FASB.

Federal Reserve Board, 2004, Agencies issue final rule on capital requirements for abcp conduits, Available at http://www.federalreserve.gov/boarddocs/press/bcreg/2004/20040720/attachment.pdf.

Federal Reserve Board, 2009, Agencies seek comment on proposed regulatory capital standards related to adoption of statements of financial accounting standards nos. 166 and 167, Available at https://www.federalreserve.gov/newsevents/press/bcreg/20090826a.htm.

Federal Reserve Board, 2010, Agencies issue final rule for regulatory capital standards related to statements of financial accounting standards nos. 166 and 167, Available at https://www.occ.gov/news-issuances/news-releases/2010/nr-ia-2010-6a.pdf.

Financial Stability Board, 2015, Global shadow banking monitoring report.

Gan, Jie, 2007, The real effects of asset market bubbles: Loan- and firm-level evidence of a lending channel, *Review of Financial Studies* 20, 709–734.

Gande, Amar, and Anthony Saunders, 2012, Are banks still special when there is a secondary market for loans, *Journal of Finance* 67, 1649–1684.

Griliches, Zvi, 1990, Patent statistics as economic indicators: a survey, *Journal of Economic Literature* 28, 1661–1707.

Gu, Yuqi, Connie X. Mao, and Xuan Tian, 2016, Bank interventions and firm innovation: Evidence from debt covenant violations, Working Paper.

Hale, Galina, and Joao Santos, 2009, Do banks price their informational monopoly?, *Journal of Financial Economics* 93, 185–206.

Hall, Bronwyn H., Adam B. Jaffe, and Manuel Trajtenberg, 2001, The NBER patent and citation data file: lessons, insights, and methodological tools, Unpbulished working paper, National Bureau of Economic Research, Combridge, MA.

Hall, Bronwyn H., Adam B. Jaffe, and Manuel Trajtenberg, 2005, Market value and patent citations, *RAND Journal of Economics* 36, 16–38.

Hall, Bronwyn H., and Josh Lerner, 2010, The financing of R&D and innovation, in Bronwyn H. Hall and Nathan Rosenberg, (eds.) *Handbook of the Economics of Innovation*, 609–639 (Elsevier–North–Holland, Amsterdam).

He, Jie, and Xuan Tian, 2013, The dark side of analyst coverage: the case of innovation, *Journal of Financial Economics* 109, 856–878.

Hendricks, Bradley E., Jed J. Neilson, and Christopher D. Williams Catherine Shakespeare, 2016, Responding to regulatory uncertainty: Evidence from basel III, Working paper.

Higgins, Eric, and Joseph Mason, 2004, What is the value of recourse to asset-backed securities? a clinical study of credit card banks, *Journal of Banking and Finance* 28, 875–899.

Holmstrom, Bengt, 1989, Agency costs and innovation, *Journal of Economic Behavior and Organization* 12, 305–327.

Hombert, Johan, and Adrien Matray, 2016, The real effects of lending relationships on innovative firms and inventor mobility, *Review of Financial Studies* Forthcoming.

Hsu, Po-Hsuan, Xuan Tian, and Yan Xu, 2014, Financial development and innovation: cross–country evidence, *Journal of Financial Economics* 112, 115–135.

IMF, 2014, Risk taking, liquidity, and shadow banking: Curbing excess while promoting growth, Global Financial Stability Report.

Kashyap, Anil, Jeremy Stein, and Samuel Hanson, 2010, An analysis of the impact of substantially heightened capital requirements on large financial institutions, Working Paper.

Kerr, William, and Ramana Nanda, 2015, Financing innovation, *Annual Review of Financial Economics* 7, 445–462.

Keys, Benjamin, Tanmony Mukherjee, Amit Seru, and Vikrant Vig, 2010, Did securitization lead to lax screening? evidence from subprime loans, *Quarterly Journal of Economics* 125, 307–362.

King, Robert G., and Ross Levine, 1993, Finance and growth: Schumpeter might be right, *Quarterly Journal of Economics* 108, 717–737.

Kogan, Leonid, Dimitris Papanikolaou, Amit Seru, and Noah Stoffman, 2016, Technological innovation, resource allocation, and growth, *Quarterly Journal of Economics* Forthcoming.

Kortum, Samuel, and Josh Lerner, 2000, Assessing the contribution of venture capital to innovation, *RAND Journal of Economics* 31, 674–692.

Landsman, Wayne, Kenneth Peasnell, and Catherine Shakespeare, 2008, Are asset securitizations sales or loans?, *The Accounting Review* 83, 1251–1272.

Lemmon, Michael, Laura Xiaolei Liu, Mike Qinghao Mao, and Greg Nini, 2014, Securitization and capital structure in nonfinancial firms: An empirical investigation, *Journal of Finance* 69, 1787–1825.

Lerner, Josh, Morten Sorensen, and Per Stromberg, 2011, Private equity and long–run investment: The case of innovation, *Journal of Finance* 66, 445–477.

Loutskina, Elena, 2011, The role of securitization in bank liquidity and funding management, *Journal of Financial Economics* 100, 863–684.

Mann, William, 2016, Creditor rights and innovation: Evidence from patent collateral, working paper, available at http://ssrn.com/abstract=2356015.

Mian, Atif, and Amir Sufi, 2009, The consequences of mortgage credit expansion: Evidence from the u.s. mortgage default crisis, *Quarterly Journal of Economics* 124, 1449–1496.

Mortgage Bankers Association, 2012, Mba letter on proposed basel III rules, Available at `https://www.fdic.gov/regulations/laws/federal/2012-ad-95-96-97/2012-ad-95-96-97_c_334.pdf`.

Moshirian, Fariborz, Xuan Tian, Bohui Zhang, and Wenrui Zhang, 2015, Financial liberalization and innovation, Working Paper.

Murphy, Edward, 2013, Shadow banking: Background and policy issues, Congressional Research Service.

Nadauld, Taylor, and Michael Weisbach, 2012, Did securitization affect the cost of corporate debt?, *Journal of Financial Economics* 105, 332–352.

Nanda, Ramana, and Tom Nicholas, 2014, Did bank distress stifle innovation during the great depression?, *Journal of Financial Economics* 114, 273–292.

Niu, Flora, and Gordon Richardson, 2006, Are securitizations in-substance sales or secured borrowings? capital market evidence, *Contemporary Accounting Research* 23, 1105–1133.

Peek, Joe, and Eric Rosengren, 1997, The international transmission of financial shocks: The case of japan, *The American Economic Review* 87, 495–505.

Pozsar, Zoltan, Tobias Adrian, Adam Ashcraft, and Hayley Boesky, 2013, Shadow banking, *FRBNY Economic Policy Review* December, 1–16.

Rajan, Raghuram, 1992, Insiders and outsiders: The choice between informed and arm's length debt, *Journal of Finance* 47, 1367–1400.

Rajan, Raghuram G., and Luigi Zingales, 1998, Financial dependence and growth, *American Economic Review* 88, 393–410.

Santos, Joao, and Andrew Winton, 2008, Bank loans, bonds, and information monopolies across the business cycle, *Journal of Finance* 63, 1315–1359.

Schafer, Alexander, Isabel Schnabel, and Beatrice Weder di Mauro, 2016, Financial sector reform after the subprime crisis: Has anything happened?, *Review of Finance* 20, 77–125.

Shivdasani, Anil, and Yihui Wang, 2011, Did structured credit fuel the lbo boom?, *Journal of Finance* 66, 1291–1328.

Tian, Xiaoli, and Haiwen Zhang, 2016, Impact of fas 166/167 on credit card securitization, Working Paper.

Tian, Xuan, and Tracy Yue Wang, 2014, Tolerance for failure and corporate innovation, *Review of Financial Studies* 27, 211–255.

Wang, Yihui, and Han Xia, 2014, Do lenders still monitor when they can securitize loans, *Review of Financial Studies* 27, 2354–2391.

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.

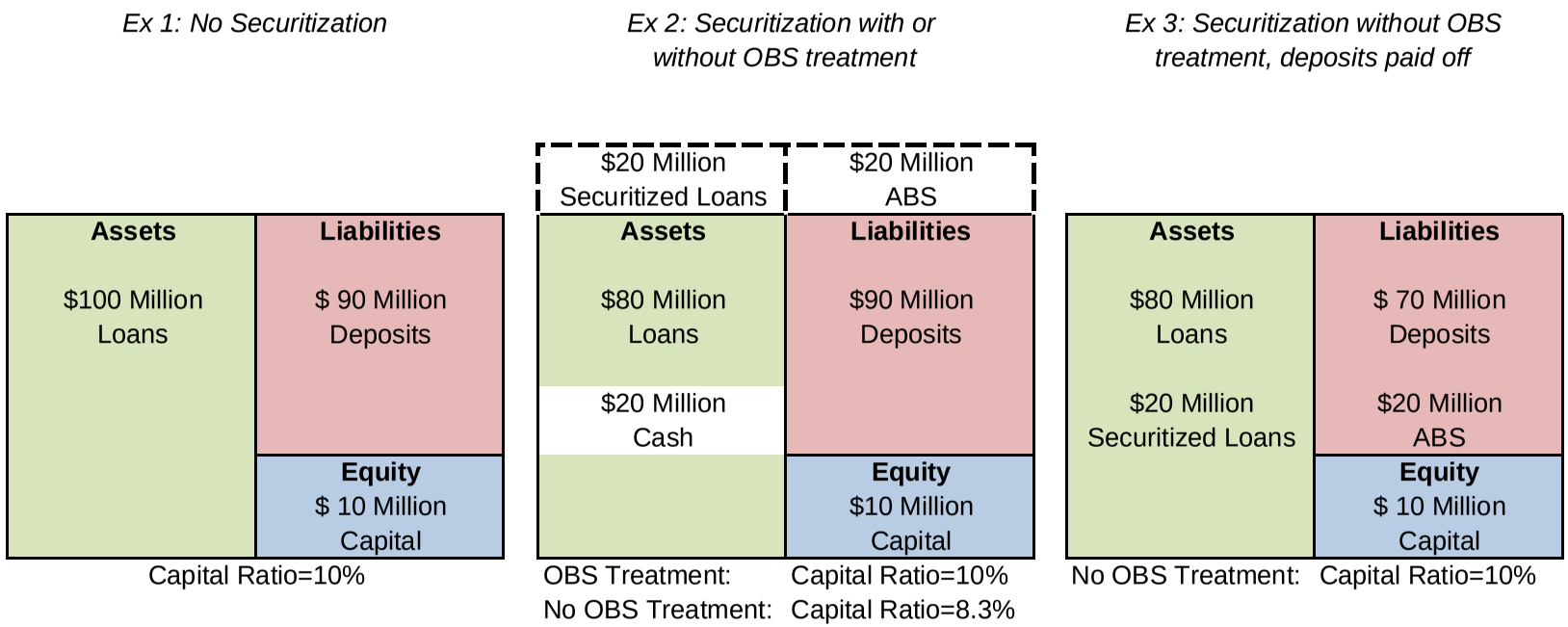

Table 1:
Summary Statistics

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 investment, 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
ΔInvestment	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×Consolidation	-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×Consolidation	-0.0227	0.0322	0.0036
	[0.0759]	[0.0387]	[0.0212]
$Post^0$×Consolidation	-0.0546	-0.0007	-0.0319
	[0.0954]	[0.0366]	[0.0225]
$Post^1$×Consolidation	-0.2999*	-0.0307	-0.0306
	[0.1519]	[0.0402]	[0.0193]
$Post^{2+}$×Consolidation	-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 $C\&I Loans$ 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.

	$R\&D_t$	$Patent_{t+1}$	$Patent_{t+2}$	$Citations_{t+1}$	$Citations_{t+2}$
Post×Consolidation	-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×Consolidation	-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×Consolidation	-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×Consolidation	-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×Consolidation	-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×Consolidation	-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×Consolidation	-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 sample of match 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 Banks	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