Securitization, Monetary Policy and Bank Stability

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Abstract

We provide new evidence about the effect of securitization activities on bank stability and systemic risk in the run-up to and following the global financial crisis by considering the role of monetary policy interest rates. In so doing, we propose *S–score* as a new measure of the net effect of securitization activities on bank stability. Analyzing the dynamics of this measure at the individual bank level and the banking system level shows that securitization activities have a destabilizing effect on banks. We also find that securitization increases commonality of asset returns among banks leading to increased interconnectedness and systemic risk. We also find that low monetary policy interest rates in the aftermath of the global financial crisis have mitigated the destabilizing effect of securitization on banks.

Keywords: Securitization, Bank Profitability, Bank Risk, Bank Stability, Systemic Risk; Monetary Policy

JEL Classification: G21; G10

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1. Introduction

Securitization has fundamentally altered the way in which financial intermediation is organized as it has provided banks with an innovative way to improve efficiency and performance. Banks may be incentivized to use securitization in order to improve their cost of funding (Pennacchi, 1988), to improve their risk management (Cebenoyan and Strahan, 2004), or to improve their profitability (Affinito and Tagliaferri, 2010). However, these benefits for individual banks remain largely theoretical given that empirical evidence does not uniformly support them. Further, securitization was blamed for increasing systemic risk and being a primary cause of the 2008 US mortgage crisis where it acted as the vehicle for the increase in lower-quality subprime debt.

This paper contributes to three different strands of academic research. The first strand aims to understand the effects of securitization on bank performance and stability. In particular, this paper examines how securitization affects both bank profitability and risk and how these effects in turn determine the net impact of securitization on bank stability. The second strand is related to the effect of securitization on systemic risk at the banking system level. This paper examines the commonality among the returns from securitization activities of banks as an indicator of systemic risk in the banking system. The third strand of research is related to the relationship between securitization and monetary policy. In particular, this paper examines whether the low interest rates in the aftermath of the global financial crisis have improved or worsened the effects of securitization. That said, our analyses differentiate between the period that preceded and the period that succeeded the global financial crisis of 2008 in order to account for the structural differences in both the banking industry and securitization markets.

We first analyze the relationship between profitability and risk of banks that engage in securitization activities compared to non securitizer banks. Given the dependency in bank profitability and simultaneity between profitability and risk, we use a dynamic panel data model to adjust for these issues. We estimate this model using the dynamic system generalized method of moments (System-GMM) estimation method which accounts for simultaneity, unobserved heterogeneity, and dynamic endogeneity in dynamic panel data models. The results suggest a trade-off between profitability and risk for banks that en-

gage in securitization activities compared to non securitizer banks. In other words, for a securitizer bank to increase its profitability, it needs to bear more risks.

We then analyze whether securitization activities can explain this trade-off between profitability and risk. In so doing, we develop a framework that combines insights from the strand of research that focuses on the effects of securitization on bank performance (e.g. Casu et al., 2011, 2013) and the strand of research that focuses on the channels through which securitization affects bank performance (e.g. Loutskina, 2011; Loutskina and Strahan, 2009). In particular, we develop a structural model of bank performance as a function of securitization activities, that consists of a system of simultaneous equations. This approach enables us to simultaneously consider the effects of securitization on both profitability and risk, while accounting for the two main channels through which securitization affects profitability and risk, namely liquidity and cost of funding.

The results show that securitization can explain why profitability and risk of securitizer banks tend to increase together. On the one hand, securitization improves banks profitability by allowing banks to sell less liquid loans and use the generated funds to grant new loans, hence, increasing fee-based revenues. On the other hand, the increase in profitability comes at the expense of increasing bank risk as banks expand their risk taking securitization activities given their ability to securitize loans and shift associated risk to capital markets.

Further, we propose a new index to measure the impact of securitization on bank stability (*S–score*) that effectively captures banks' net exposure to securitization activities. To construct this index, we adjust our structural model of the bank performance to account for risk-adjusted profitability as a function of securitization activities, instead of considering profitability and risk separately. As a result, the *S–score* can be thought of as a measure of the sensitivity of the bank risk-adjusted profitability to its engagement in securitization activities, where the sensitivities are estimated based on a structural model of bank stability that accounts for the main channels through which securitization affects bank risk-adjusted profitability. We estimate *S–score* at the loan portfolio level and the overall balance sheet level, for both individual banks and the banking system as a whole.

The results show that securitization activities are destabilizing at the bank level. The net impact of securitization on banks is generally negative when we measure bank performance based on risk-adjusted profitability measures. This impact is negative whether at the loans portfolio level or the overall balance sheet level. This destabilizing effect is more significant in the period that led to the global financial crisis in 2008 compared to the period that followed the crisis. In addition, the dynamics of $S\text{–}score$ at the banking system level show that the destabilizing impact of securitization is more severe in the run-up to the global financial crisis, whereas it bottoms out during the crisis. Following the crisis, the destabilizing effect seems to have declined. Nevertheless, neither our estimate of $S\text{–}score$ at the loan portfolio level nor at the balance sheet level show any significant positive effects of securitization on bank stability, even in the aftermath of the global financial crisis.

We further extend our analysis to evaluate the systemic effects of securitization at the banking system level. To this end, we implement the principal components analysis approach suggested by Billio et al. (2012) to measure the commonality among returns from securitization activities of banks as an indicator of the systemic effects of securitization activities. It is expected that the first few components will capture a larger portion of the total volatility when returns tend to move together, which is often associated with crisis periods. Therefore, we analyze the systemic effects of securitization by examining the portion of volatility in returns from securitization activities that is explained by the first few principal components. An increase in this portion is indicative of increased commonality in returns from securitization activities and increased interconnectedness among banks, and accordingly higher systemic risk.

The results suggest that the first principal component was increasing in the run-up to the global financial crisis, and then peaked exactly at the end of 2008. On average, the first principal component explains a much higher portion of the volatility in returns from securitization activities in the period that preceded the global financial crisis compared to the period that followed the crisis. This implies that securitization activities have contributed to increasing interconnectedness among banks in the run-up to the global

financial crisis, hence increasing systemic risk in the banking system.

An interesting finding throughout our analysis is that the effects of securitization on either profitability, risk, stability, or systemic risk differ significantly between the period that preceded and the period that succeeded the global financial crisis of 2008. We put forward an explanation for this difference. We argue that the severe decline in monetary policy short-term interest rates might have affected bank incentives to securitize loans and has mitigated the destabilizing impact of securitization on banks following the onset of the crisis. We put this argument to the test using an identification strategy centred around the exogenous monetary policy shock that coincided with the crisis. In particular, to analyze how the net impact of securitization activities depends on monetary policy interest rates, we employ a difference-in-differences (DID) approach in which we compare the *S–score* of banks before and after the decline in monetary policy rates following the crisis. In other words, we evaluate whether the destabilizing impact of securitization has changed around the dramatic decline in short-term interest rates following the crisis. We estimate this difference-in-differences model using a balanced window of eight years of data surrounding the fourth quarter of 2008.

The results show that *S–score*, either measured at loan portfolio level or the balance sheet level, has improved in the low interest rate period compared to the higher interest rate period. Nevertheless, the magnitude of improvement in the destabilizing effect of securitization is higher when measured at the loan portfolio level compared to being measured at the balance sheet level. In addition, the magnitude of this improvement is supported by our previous estimates of *S–score* at the banking system level. Overall, the results support the mitigating role of low interest rates on the net impact of securitization on bank stability as measured by *S–score*.

Finally, given that in response to the global financial crisis, several regulatory initiatives were enacted, the effect of monetary policy interest rates could be commingled with the effects of other policy initiatives that coincided with monetary policy decline following the crisis.[4] Therefore, to check the robustness of our results from the difference-

[4]Examples include the Housing and Economic Recovery Act of 2008, and the Dodd-Frank Act of

in-differences analysis, we conduct an additional test in which we examine the impact of monetary policy interest rates on the return and riskiness of securitization activities. This approach has the added benefit of explicitly considering the direct impact of monetary policy interest rates on the profitability and riskiness of securitization activities, which translates into effects on bank stability.

The results support the view that the decline in monetary policy rates in the period that followed the crisis has contributed to mitigating the destabilizing impact of securitization. On the one hand, our results show that changes in short-term interest rates have positively affected both profitability and riskiness of securitization activities in the run-up to and the period that followed the crisis. On the other hand, the results show that the magnitude of this impact declines significantly in the period that followed the crisis, with a more dramatic decline in the case of riskiness of securitization activities. Put together, these findings lead us to conclude that the decline in monetary policy interest rates have worked to mitigate the destabilizing impact of securitization in the aftermath of the crisis.

This paper contributes to the strand of literature that explores the impact of securitization on bank performance. Securitization enables banks to convert illiquid assets quickly into cash and to remove liabilities associated with these assets from their balance sheets. The cash proceeds from securitization can be used in different ways. For example, it can be used to replace existing funding sources such as deposits, consequently, reducing interest expense accrued for these deposits, and leading to higher reported earnings (Marques-Ibanez and Scheicher, 2012). Additionally, banks can use these proceeds to grant new loans that can be securitized later, thus repeating the same process and creating an asset-securitization pipeline structure (Wolfe, 2000). This structure allows banks to receive fee income for servicing the securitized loans, and to improve their return on equity effectively because the new income can be supported by a smaller equity base (Kopff and Lent, 1990). Moreover, proceeds from securitizations can be reinvested in loans directed to new profitable projects, thus aligning the average rate of the bank's loan portfolio with the market rate and increasing the bank's income from interest (Thomas, 1999). These views on the positive impact of securtitization are also supported by some em-

2010.

pirical studies. While Greenbaum and Thakor (1987) suggest that securitization allows banks to specialize in activities of comparative advantage and to shifting the activities of comparative disadvantage, Boot and Thakor (1993) show that in the presence of asymmetric information, securitization of assets enables the issuer to increase its expected revenue. Nevertheless, studies on the U.S. banks are not conclusive. Jiangli et al. (2008) show that U.S. banks would have been more profitable without securitization activites, whereas Casu et al. (2013) compare between securitizers and non-securitizers based on different performance indicators, and find that profitability is significantly and positively affected by securitization.

This paper also contributes to the line of research on the impact of securitization on bank risk. Instefjord (2005) suggest that this impact is twofold. On the one hand, it may reduce bank risk by shifting credit risk to the market and improving risk sharing opportunities. In support of this view, Cebenoyan and Strahan (2004) argue that aggressive use of securitization encourages banks to take more risk; however, the new risk is still outweighed by the credit risk initially transferred to investors. Jiangli et al. (2008) show that securitization reduces insolvency risk. They provide evidence that, during the 2007-2009 credit crisis, mortgage credit and securitization markets disorders were due to excess supply in those markets. Affinito and Tagliaferri (2010) show that banks tend to keep high-quality loans while securitizing their worst loans. Similarly, some studies demonstrate that in the run up to the credit crisis, US banks managed to securitize their worst mortgage loans, thus reducing credit risk (see Mian and Sufi, 2009). On the other hand, securitization may increase bank risk due to the increase in risk taking and recourse or other seller-provided credit enhancements (Higgins and Mason, 2004). Ambrose et al. (2005) suggest a positive effect of securitization on bank credit risk due to retaining riskier loans while selling safer ones in response to regulatory requirements. Calomiris and Mason (2004) and Casu et al. (2011) show that high amounts of outstanding securitizations reduced U.S. banks risk appetite prior to the financial crisis. They attribute this to the recourse hypothesis implying an already high credit risk. Moreover, Bedendo and Bruno (2012) provide evidence that U.S. banks intensively used securitization to obtain funds, in times of frozen liquidity markets during the financial crises, at the expense of higher overall bank risk. Similar evidence is provided for European banks in Uhde and Michalak

(2010) and for Italian banks in Battaglia and Gallo (2013).

The remainder of this paper is organised as follows. Section 2 provides an institutional background and an overview of the data sample. Section 3 analyzes the relationship between profitability and risk of securitizers. Section 4 explains the trade-off in bank performance using securitization activities. Section 5 analyzes the impact of securitization on bank stability and systemic risk. Section 6 evaluates the role of monetary policy in determining the effects of securitization. Section 7 concludes the paper.

2. Background and Data

This section provides an overview of the US banking industry and securitization market, in addition to the data sample and variables used throughout the analysis in subsequent sections.

2.1. Institutional Background

The US banking industry has experienced an enormous transformation over the course of the last few decades. One of these transformations was a trend of increase in the portion of industry income generated from fees-based activities (such as securitization) rather than interest-generating activities starting from the 1980s. This trend has fundamentally altered the risk-return profiles of US banks over the last few decades (DeYoung and Roland, 2001). Particularly, banks cost of production were static or declining and there has been an increase in total revenues from traditional and non-traditional sources. This meant that by the mid-2000s, US banks profitability was very strong (Carlson and Weinbach, 2007). Indeed, until mid-2007 it was widely perceived that the US banking system was sound and performing well, particularly because banks capital holdings and profitability appeared to be high and at record levels. Nevertheless, Clark et al. (2007) emphasize how the increasingly fee-focused strategies of large US banks expose these banks to economic and business cycle volatility. With the onset of the mortgage crisis, problems in the housing market spilled over to the banking industry. The increased number of foreclosures and defaults in mortgages led to a decline in the value of securitized assets and reduced investors appetite for such securities and accordingly problems within the US banking industry (Gerardi et al., 2008).

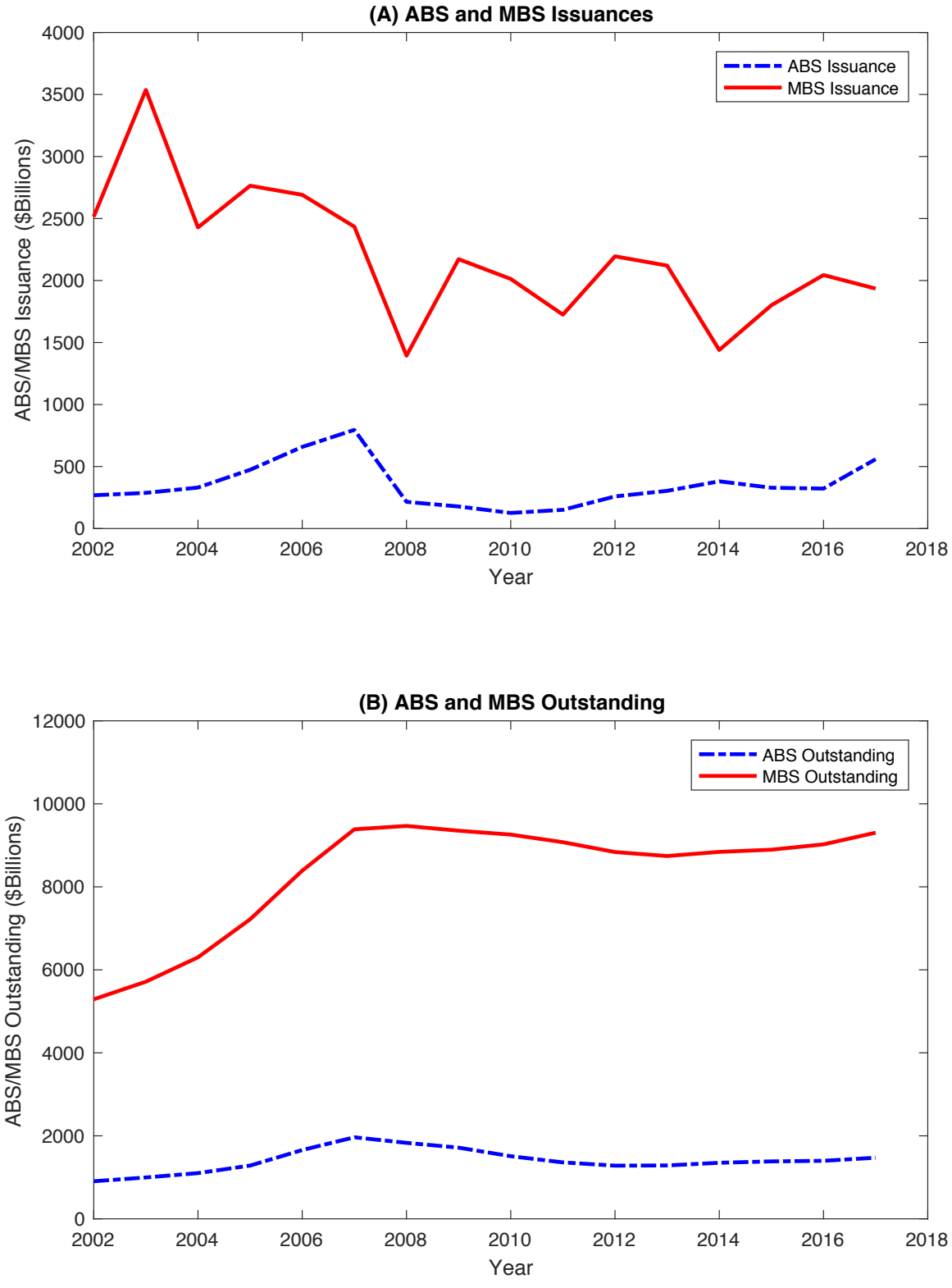

Figure 1: **Securitization Market in the United States**
This figure presents the main developments in the US securitization market between 2002 and 2017. Panel (A) shows issuances of Asset-Backed Securities (ABS) and Mortgage-Back Securities (MBS). Panel (B) shows outstanding amounts of Asset-Backed Securities (ABS) and Mortgage-Back Securities (MBS). All amounts are in billions of US Dollars. Data Source: Securities Industry and Financial Markets Association (SIFMA).

In the US, securitization origins go back to the early 1970s, when Government National Mortgage Association (Ginnie Mae) started to sell mortgage loans (Marques-Ibanez and Scheicher, 2009). Then, In the 1980s, the market grew with the issuances of securities by the semi-governmental agencies, Federal Home Loan Mortgage Corporation (Freddie Mac) and the Federal National Mortgage Association (Fannie Mae). Initially, securitization processes included mortgage loans forming what is known as Mortgage Backed Securities (MBS). Later, they expanded to include other types of loans forming what is known as Asset Backed Securities (ABS). Furthermore, in the run-up to the 2008 credit crisis, more sophisticated forms of securitization were developed such as Collateralized Mortgage Obligations (CMO). Securitization activities played a pivotal role for the housing market in the run-up to the credit crisis of 2008 as the Asset Backed Securities (ABS) and covered bonds provided between 20 and 60 per cent of the funding for new residential mortgage loans originated in mature economies (International Monetary Fund, 2009).

Figure 1 presents the issuances and outstanding amounts of ABS and MBS in the US between 2002 and 2017. Historically, the MBS activities have dominated the securitization market. The total volume of outstanding MBS in the US increased from $347 million in 1970 to nearly $8.92 trillion at the end of 2016, while the ABS market moved from $1.2 billion in 1985 to nearly $1.33 trillion at the end of 2016 (Securities Industry and Financial Markets Association, 2016). Also, it is worth noting that the outstanding securitization amounts reached a peak of $11 trillion at the end of 2007, exactly before the onset of the credit crisis of 2008. In addition, the growth in securitization activities was rapid in the run-up to the global financial crisis, but contracted sharply since the financial crisis in 2008 as shown by the large declines in the securitization issuances. For example, Securitization issuance, including agency and non-agency MBS and ABS, totalled $2.2 trillion in 2016 which is equivalent to around two-thirds of the pre-crisis annual rate, and mainly driven by agency MBS.

2.2. The Data

In this subsection, we provide an overview of the data sample and variables used in our analysis.

2.2.1. Sample

This paper considers the effect of securitization activities on the profitability and risk of banks, and how the changes that securitization causes in bank performance affect its stability. We further consider how the impact of securitization on bank performance and stability depends on the prevailing monetary policy. We obtain data on securitization activities of the U.S commercial banks from the Reports of Condition and Income (Call Reports), which are available quarterly from the Federal Financial Institutions Examination Council (FFIEC).[5] Given that these detailed information on securitization activities started to be required from reporting banks from the second quarter of 2001, our sample covers the period from 2001Q2 through 2017Q4. We also use the Call Reports data for other information about bank profitability and risk. In addition, our monetary policy and macroeconomic data come from the Federal Reserve Economic Data (FRED), while data on the U.S banking industry are retrieved from the World Development Indicator (WDI) database provided by the World Bank.

When constructing the sample, bank-quarters with missing information on total assets, liquidity, loans, deposits, capital, and net income are excluded from the data set. Exploring the data set shows that securitization activities of small banks are infrequent and insignificant. Therefore, we also exclude any bank-quarters with total assets less than $500 million. In addition, to ensure that the sample is as balanced as possible, we exclude banks that are acquired through a merger or acquisition using bank mergers data from the Federal Reserve National Information Center. Specifically, we exclude the target bank in the quarters before a merger. Furthermore, to prevent the possibility of outliers driving the results, quarterly variables computed from the sample are winsorised at the 1% level, that is, the smallest and largest 1% of the values of each variable is replaced with the closest value. The final data set contains 81,326 bank-quarters. To analyse differences in the securitization effects over the sample period, we separate the sample into two subsamples: 2001Q2-2008Q4 and 2009Q1-2017Q4. The first period represents tight monetary policy with relatively high interest rates and the second period represents

[5]The data are available as complete balance sheet, income statement, and detailed supporting schedules for each reporting bank. Data about securitization activities of the reporting banks are included in a separate schedule for off-balance-sheet items (RC-S).

a loose monetary policy with relatively low interest rates. In the subsections below, we discuss these data and variables in more detail.

2.2.2. Bank Securitization Activities

The main explanatory variable in our analysis is the amount of outstanding securitization. We measure securitization by the ratio of all outstanding securitized loans to total assets. Further, for robustness we divide outstanding securitization into mortgage-backed securitization which includes both residential and commercial mortgage-backed securitized loans, and asset-backed securitization which includes consumer credit, auto loans, credit cards, and commercial and industrial loans. While scaling securitized loans by total assets or total loans yields similar empirical results, we opt to use the ratio of securitization to total assets. Scaling by total assets allows for better interpretation of results given that other bank-level variables are calculated as ratios of total assets.

2.2.3. Bank Profitability and Risk

Given our focus on the effects of securitization on bank performance, we use two measures of bank profitability that are widely used in literature: return on assets and net interest margin (Berger, 1995). Return on assets is the traditional measure of bank profitability that measures how well bank assets are being used to generate profits. It is calculated as the ratio of net income to total assets, hence, it corrects for bank size. Securitization activities are expected to affect return on assets directly given that income from securitization is included when calculating net income of banks. Net interest margin is another useful measure of bank profitability that is calculated as the difference between interest income and interest expenses scaled by total assets. Securitization activities are expected to affect net interest margin indirectly through their impact on the composition and quality of the loan portfolio which in turn determines the interest income. Using these two different measures provides an advantage as it allows us to capture the overall effects of securitization on bank profitability when using return on assets, while we can assess the effects of securitization on the profitability of the bank loan portfolio using net interest margin.

In addition, given our focus on the effects of securitization on bank performance, we use two different proxies for bank risk following (Casu et al., 2013) including the

ratio of risk-weighted assets and allowances ratio. The first measure is calculated as the ratio of risk-weighted assets to total assets and captures the overall riskiness of bank assets. This measure is more suitable to account for the overall impact of securitization on bank risk. Alternatively, we use the allowances ratio which is calculated as the ratio of allowance for loan losses to total assets as another proxy for bank risk. This measure captures the riskiness of the bank loan portfolio, hence enables us to focus on the effects of securitization on the riskiness of the bank loan portfolio as comparable to total assets.

2.2.4. Monetary Policy

Critical to our analysis is the role of monetary policy in determining the effect of securitization on bank performance and stability. Specifically, to proxy the monetary policy stance, we use end of quarter effective federal funds rate provided by the Board of Governors Release H.15. The federal funds rate is the prevalent measure of monetary policy in empirical work and is well suited to capture the stance of monetary policy because it is sensitive to shocks to the supply of bank reserves and increases in its level represent monetary policy tightening (Bernanke and Blinder, 1992). Figure 2 presents the end-of-quarter effective federal funds rate in the United States over the sample period from 2001 to 2017. To analyse differences in the securitization effects over the sample period, we use this measure to separate the sample into two sub-periods. The first sub-period starts from 2001Q2 through 2008Q4 and represents monetary policy tightening with relatively high federal funds rates. The second sub-period starts from 2009Q1 through 2017Q4 and represents monetary policy loosening with relatively low federal funds rates.

2.2.5. Summary Statistics

Table 1 presents summary statistics for various variables in our sample. We report the mean, standard deviation, minimum and maximum values for each variable for the full sample and for the two sub-samples of high and low interest rates. Panel A shows that the composition of banks' balance sheets has changed over time. Of the noticeable changes is the average decline in return on assets from 0.75% to 0.47%, while the net interest margin has slightly declined from 2.3% to 2.07%, on average. Meanwhile, the overall riskiness of bank assets has improved as measured by risk-weighted assets (77% versus 71%), while the allowances ratio has remained stable at around 1.5% and 1.7%.

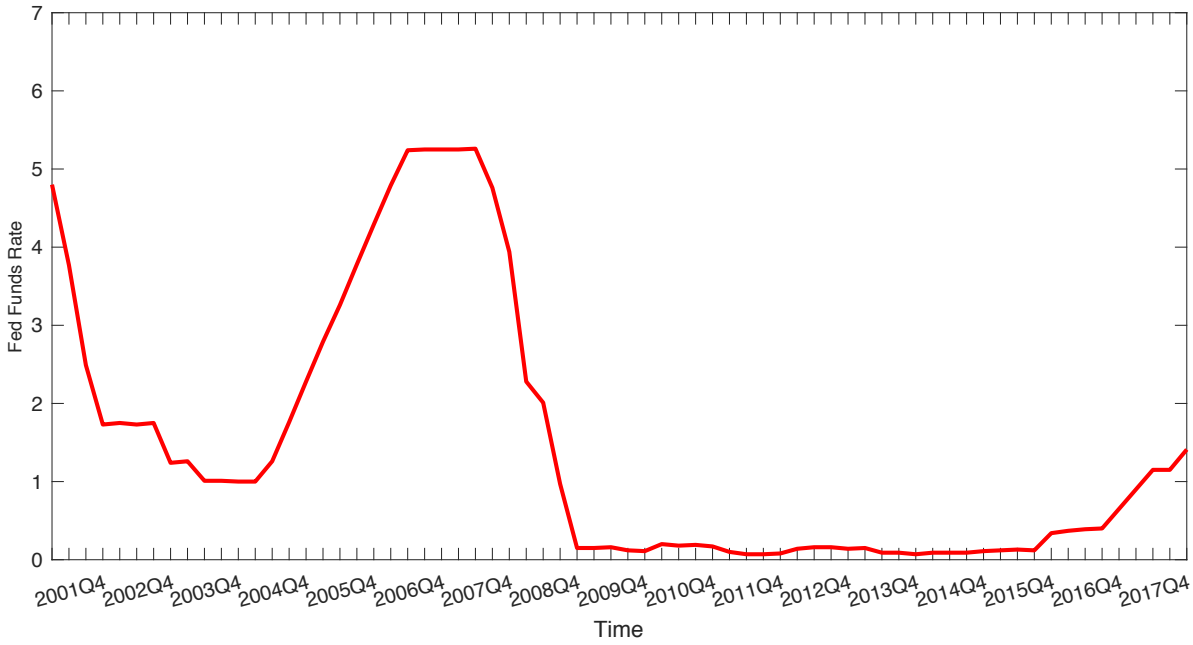

Figure 2: **Federal Funds Rate in the United States**
This figure presents the end-of-quarter effective federal funds rate in the United States over the sample period from 2001 to 2017. Data Source: Federal Reserve Economic Data (FRED).

When comparing statistics for securitization activities between the two sub-periods as shown in panel B, we notice a significant decline in outstanding securitized loans from 37.97% to 18.56%. The decline is more severe for asset backed securitization as compared to mortgage-backed securitization. In addition, the net securitization has witnessed a severe decline from 1.9% to 0.29%. This is consistent with the impairment of the securitization markets and the decline in issuances following the credit crisis. Turning to monetary policy, panel C shows that federal funds rate has declined significantly from 2.78% in the first sub-period as compared to 0.28% in the second sub-period.

3. The Trade-off Between Profitability and Risk

In this section, we empirically evaluate the relationship between profitability and risk of banks that engage in securitization activities. Literature on the determinates of bank profitability is voluminous with a focus on two broad groups of determinants: internal and external. Internal determinants of bank profitability are those factors that can be altered by the bank decisions, while external determinants include industry-specific and

Table 1: Summary Statistics

	2001Q2-2017Q4					2001Q2-2008Q4					2009Q1-2017Q4				
	N	Mean	Std. Dev.	Min	Max	N	Mean	Std. Dev.	Min	Max	N	Mean	Std. Dev.	Min	Max
Panel A: Bank Level Variables															
Return on Assets	81,326	0.0058	0.0128	-0.4467	0.7289	32,472	0.0075	0.0144	-0.4467	0.5504	48,854	0.0047	0.0114	-0.4267	0.7289
Net_Interest_Margin	81,326	0.0216	0.0140	-0.0289	0.3628	32,472	0.0230	0.0149	-0.0289	0.2895	48,854	0.0207	0.0132	-0.0149	0.3628
Risk-Weighted Assets	81,326	0.7209	0.1610	0.0001	1.6223	32,472	0.7430	0.1816	0.0856	1.6223	48,854	0.7063	0.1439	0.0001	1.5323
Allowance Ratio	81,326	0.0158	0.0175	0.0000	0.1740	32,472	0.0146	0.0198	0.0000	0.1740	48,854	0.0167	0.0157	0.0000	0.1510
Interest expense Ratio	81,326	0.0094	0.0090	0.0000	0.3628	32,472	0.0159	0.0101	0.0000	0.2538	48,854	0.0050	0.0050	0.0000	0.3628
Liquidity ratio	81,326	0.2654	0.1512	0.0005	0.9868	32,472	0.2505	0.1518	0.0005	0.9568	48,854	0.2753	0.1499	0.0006	0.9868
Size	81,326	14.1642	1.2693	9.6469	21.4901	32,472	14.1592	1.2739	9.6469	21.0417	48,854	14.1675	1.2662	9.7042	21.4901
Total risk based capital ratio	81,326	0.1456	0.1340	0.0000	0.5556	32,472	0.1480	0.1217	0.0000	0.5056	48,854	0.1441	0.1146	0.0000	0.5556
Equity ratio	81,326	0.1092	0.0582	0.0114	0.8698	32,472	0.1055	0.0639	0.0114	0.8498	48,854	0.1115	0.0530	0.0143	0.8698
Trading Assets ratio	81,326	0.0022	0.0218	0.0000	0.3393	32,472	0.0035	0.0302	0.0000	0.3393	48,854	0.0012	0.0112	0.0000	0.3093
Loan to Assets ratio	81,326	0.6645	0.1613	0.0000	0.9005	32,472	0.6687	0.1708	0.0000	0.9005	48,854	0.6617	0.1547	0.0000	0.8654
Deposits to Assets ratio	81,326	0.7762	0.1387	0.0000	0.9554	32,472	0.7405	0.1672	0.0000	0.9154	48,854	0.7999	0.1098	0.0000	0.9554
Panel B: Securitization Activities															
Securitization to total assets	7,593	0.2829	1.2456	0.0000	69.1727	3,807	0.3797	1.6688	0.0000	69.1727	3,786	0.1856	0.5411	0.0000	4.6822
MBS	7,593	0.0842	0.2992	0.0000	4.6324	3,807	0.0497	0.1362	0.0000	2.2801	3,786	0.1190	0.3982	0.0000	4.6324
ABS	7,593	0.1987	1.2169	0.0000	69.1727	3,807	0.3300	1.6725	0.0000	69.1727	3,786	0.0667	0.3501	0.0000	4.1783
Net Securitization Income on Assets	3,682	0.0131	0.0501	-0.0719	0.5586	2,376	0.0187	0.0608	-0.0719	0.5586	1,306	0.0029	0.0135	-0.0646	0.2309
Panel C: Macroeconomic Variables															
GDP Growth	67	1.8676	2.3668	-8.2000	6.9000	31	1.7969	2.7485	-8.2000	6.9000	36	1.9306	2.0058	-5.4000	5.2000
Federal Funds Rate	67	1.4591	1.7059	0.0700	5.2600	31	2.7847	1.6531	0.1500	5.2600	36	0.2808	0.3400	0.0700	1.4100
Boone Indiator	67	-0.0554	0.0140	-0.0853	-0.0397	31	-0.0675	0.0099	-0.0853	-0.0562	36	-0.0446	0.0060	-0.0554	-0.0397
ROA_System	67	0.0023	0.0012	-0.0027	0.0034	31	0.0026	0.0014	-0.0027	0.0034	36	0.0021	0.0010	-0.0009	0.0028
NSI_System	67	0.0003	0.0003	0.0000	0.0007	31	0.0005	0.0001	0.0002	0.0007	36	0.0000	0.0000	0.0000	0.0002

macroeconomic factors that are not under the control of banks.

The literature reports a variety of internal factors that determine bank profitability with bank risk being a major factor that affects profitability. The predominant types of risks that affect banks are credit risk, market risk, and liquidity risk. Higher credit risk implies higher loan loss provisions, and accordingly lower returns achieved by banks. Hence, excess exposure to credit risk reduces profitability (Bourke, 1989; Miller and Noulas, 1997). The impact of liquidity risk on bank profitability is less straightforward. Liquidity can affect bank profitability in both directions. It can reduce profitability when liquid assets with lower rates of return increase (Guru et al., 2002; Molyneux and Thornton, 1992), still some empirical research shows a positive impact of liquidity on bank profitability (Bourke, 1989; Pasiouras and Kosmidou, 2007). Bank size captures the ability of a bank to reduce costs due to economies of scale and scope and hence increasing profitability (Goddard et al., 2004). The level of capital can also affect bank profitability. It can improve profitability if it improves the soundness of the bank resulting in lower cost of funding from other sources (Demirgüç-Kunt and Huizinga, 1999; Pasiouras and Kosmidou, 2007) or it can reduce bank profitability if banks are required to increase their balance of high quality assets that qualify as capital, but have relatively low rates of return (Dietrich and Wanzenried, 2011). In addition, some studies show that cost of funding has a direct and positive impact on profitability (Berger, 1995; Demirgüç-Kunt and Huizinga, 1999; Kosmidou, 2008; Kosmidou et al., 2007). The balance sheet composition can also affect bank profitability. For instance, the higher the loans to assets ratio, the higher the bank profitability because lending portfolio is expected to generate higher returns compared to other asset categories.

Additionally, competition is the main industry-specific determinant of bank profitability. It might improve efficiency leading to cost reductions and higher profitability (Claessens and Laeven, 2004), or it might force banks to charge lower rates on lending resulting in lower profitability (Martinez-Miera and Repullo, 2010). Furthermore, real GDP growth is a macroeconomic determinant of bank profitability. It captures the improvement in business conditions and increased demand for lending leading to higher profitability as shown by Demirgüç-Kunt and Huizinga (1999). Inflation measures

macroeconomic stability and can also affect bank profitability because unanticipated inflation can lead to inaccurate pricing of loans and increase in loan loss rates which implies lower profitability (Lee and Hsieh, 2013).

3.1. Econometric Specification

As discussed above, we aim to investigate the relationship between profitability and risk of banks that engage in securitization activities in comparison with other banks that do not participate in securitization market. Specifically, we investigate the change in profitability of banks in a specific quarter in response to changes in bank risk, depending on the banks' exposure to the securitization activities. Further, we expect bank profitability to show dependency over time. Therefore, we estimate the following dynamic panel data model:

$$PROFIT_{i,t} = \alpha_i + \beta_1\, PROFIT_{i,t-1} + \beta_2\, iSEC + \beta_3\, iSEC{*}RISK_{i,t-1} + \gamma\, \mathbf{X}_{i,t-1} + \theta_t + \varepsilon_{i,t} \tag{1}$$

where $PROFIT_{i,t}$ denotes bank profitability, $RISK_{i,t}$ denotes bank risk, and $\mathbf{X}_{i,t}$ is a vector of control variables. $iSEC$ is a binary indicator variable that takes the value 1 if the bank has securitization activities in a given quarter and zero otherwise. The subindices i and t denote banks and time, respectively. The parameters to be estimated are α_i, β_1, β_2. β_3, and γ. θ_t is a time-specific fixed effect. $\varepsilon_{i,t}$ is an error term. In this specification, we specifically focus on β_3, the interaction of the banks risk with the exposure of the bank to the securitization activities.

We use two different measures for profitability: net interest margin and return on assets. We also use two different measures for bank risk including the one-period lagged ratio of risk-weighted assets to total assets and the one-period lagged ratio of loan loss allowance to total assets. In addition, to help mitigate omitted variables bias, we control for bank-specific, industry-specific, and macroeconomic factors that might affect bank profitability, risk or both. First, we include the natural log of total assets to control for bank size which is expected to affect its profitability. This can be due to the economies of scale or the ability of large banks to lend more (Goddard et al., 2004), and accordingly to have better access to the securitization market due to their large and homogeneous

loans portfolios (Loutskina, 2011). Second, we include in the regression the equity ratio calculated as the ratio of Tier 1 risk-based capital to total assets. Maintaining high capital levels provides the bank with protection in case of a banking crisis, and against different risks resulting from the bank exposure to outstanding securitizations. Moreover, the protection provided by capital buffer supports the bank's profitability in the long run (Berger, 1995). Third, to control for balance sheet composition, we include two measures: the ratio of trading assets to total assets to account for other sources of bank profitability other than lending, and the ratio of deposits to total assets to account for stability of bank funding. Fourth, to control for competition in the banking system, we include the Boone indicator calculated as the elasticity of bank profits to marginal costs (Boone, 2008). The more negative the Boone indicator, the higher the degree of competition in the banking system because the effect of reallocation is stronger. Estimations of this measure are retrieved from World Development Indicator (WDI) database provided by the World Bank. Finally, we include the rate of growth in real Gross Domestic Product (GDP) to account for macroeconomic developments that could affect bank profitability and risk. It is expected that changes in GDP growth capture the effects of the business cycle on bank's profitability (Demirgüç-Kunt and Huizinga, 1999). All variables are lagged for one period to allow the effects of securitization activities to be realized in bank profitability and risk and to avoid simultaneity.

We estimate the model presented in Equation 1 using the dynamic system generalized method of moments (System-GMM) estimator in order to obtain consistent and unbiased estimates of the model parameters. This estimator was introduced by Arellano and Bond (1991) and further developed in Arellano and Bover (1995) and Blundell and Bond (1998). Using the System-GMM estimator provides several advantages in estimating our model including its ability to correct for different sources endogeneity (Wintoki et al., 2012). First, it accounts for simultaneity that stems from the fact that financial variables are likely to be determined simultaneously. For instance, for banks to achieve specific levels of profitability, bank risk taking can be adjusted which might hide the actual relation between profitability and risk. Second, the System-GMM estimator accounts for unobserved heterogeneity where some variables are omitted because they are unobservable, which could result in inconsistent estimates. An example of these unobservable

variables include management skills and ability that cannot be measured easily. Third, The System-GMM estimator accounts for dynamic endogeneity in dynamic panel data models. Specifically, including the lagged dependent variable as a regressor makes it endogenous to fixed effects in the error terms. This gives rise to dynamic endogeneity in the model specification, resulting in positive correlation between the regressor and error terms which violates the assumptions required for traditional estimators such as ordinary least squares. Thus, employing the System-GMM estimator to estimate our model provides the most consistent estimates as it accounts for the three aforementioned sources of endogeneity.

The System-GMM estimator builds a system of two equations; one in differenced variables to eliminate the potential sources of omitted variables bias in estimation and the original equation in levels to improve the efficiency of estimation (Arellano and Bover, 1995). The method then uses lags of the dependent and independent variables as instruments. In particular, variables in levels are instrumented with suitable lags of their own first differences, while the differenced variables that are not strictly exogenous are instrumented with all their available lags in levels. To assess the model specification we use two tests. First, to assess autocorrelation between error terms and regressors, we use the Arellano-Bond test for autocorrelation which is applied to the differenced residuals in order to purge the unobserved and perfectly autocorrelated individual-level effect (Arellano and Bond, 1991). Second, to assess the validity of instruments, we use the Hansen J-statistic for overidentifying restrictions which tests whether the instruments, as a group, appear exogenous, and is robust to heteroskedasticity and autocorellation (Roodman, 2009). Further, we use two-step robust estimation which is asymptotically more efficient than one-step estimation. Finally, to compensate for the downward-biased standard errors which result when using two-step System-GMM (Arellano and Bond, 1991; Blundell and Bond, 1998), we implement the finite-sample correction method derived by Windmeijer (2005) to the two-step covariance matrix.

3.2. Empirical Results

Table 2 reports the results of estimating the model specified in Equation 1. The results confirm the dependency in bank profitability and justify our use of a dynamic panel

data model. Columns (1) and (2) show that on average a 1% increase in return on assets is associated with an increase of 0.47% and 0.52% in return on assets in the following period, respectively. Similar results are obtained when using net interest margin as the measure of bank profitability. Turning to assess the impact of bank risk on its profitability, we focus on the coefficient on the interaction variable between $iSEC$ and bank risk. Columns (1) and (2) show the results using return on assets as the profitability measure. Since both profitability and risk measures are scaled by total assets, column (1) shows that a 1% increase in risk-weighted assets increases return on assets by about 0.09%. This increase is for the securitizer banks ($iSEC$ is 1) compared to non securitizers ($iSEC$ is 0). Similarly, column (2) shows that a 1% increase in allowances ratio increases return on assets by about 0.29%. The results hold when using net interest margin as our measure of bank profitability with even larger magnitude of impact. Column (3) shows that net interest margin of a securitizer bank increases by about 0.27% on average when its risk-weighted assets increases by 1%. Finally, column (4) shows that net interest margin of a securitizer bank increases by about 0.69% on average when its allowance ratio increases by 1%. It is worth mentioning that the impact of bank risk becomes even larger when we focus on the riskiness of the loan portfolio measured by the loan loss allowance ratio as compared to the overall riskiness of bank assets as measured by the risk-weighted assets ratio. This implies that the contribution of the bank's loan portfolio to its profitability is larger compared to other assets categories.

3.3. Further Evidence

To check the robustness of our results presented above, we perform two further analyses. In the first analysis, we examine whether the results hold for two subperiods: the first is 2001Q2-2008Q4 which represents the run-up to the global financial crisis in 2008, and second is 2009Q1-2017Q4 which represents the period that followed the crisis. Our motivation is to study whether the structural changes in the banking industry and securitization markets after the crisis have altered the relation between bank profitability and risk. The results of these specifications are presented in Table 3. Two findings are worth mentioning based on these results. First, the main results hold before and after the financial crisis: there is a positive and significant relationship between bank risk and bank profitability for securitizer banks compared to non-securitizer banks. This result

Table 2: **The Impact of Bank Risk on Bank Profitability I.**
This table shows the results of examining the impact of bank risk on bank profitability for securitizer compared to non-securitizer banks. Model specifications in columns 1 through 4 are estimated using the System-GMM estimation method. The sample includes quarterly data from 2001Q2 through 2017Q4. *Return_on_Assets* is the return on assets calculated as the ratio of net income to total assets. *Net_Interest_Margin* is the net interest margin calculated as the ratio of net interest income to total assets. *iSEC* is an indicator variable that takes a value of 1 if the bank has securitization activities, and a value of 0 otherwise. *RWA* is the ratio of risk-weighted assets to total assets. *ALLOW* is the ratio of loan loss allowance to total assets. *Size* is the natural logarithm of total assets. *Equity* is the ratio of Tier 1 risk-based capital ratio to total assets. *Trading_Assets* is the ratio of trading assets to total assets. *Deposits* is the ratio of bank deposits to total assets. *Boone_Ind* is the quarterly estimation of Boone indicator for the banking system. *GDP_Growth* is the rate of growth in real gross domestic product. Standard errors in parentheses. *,**,*** denote statistical significance at the 10%, 5%, and 1% level respectively.

	Return_on_Assets$_t$		Net_Interest_Margin$_t$	
	(1)	(2)	(3)	(4)
Return_on_Assets$_{t-1}$	0.4747***	0.5204***		
	(0.0031)	(0.0023)		
Net_Interest_Margin$_{t-1}$			0.089***	0.0928***
			(0.0012)	(0.0008)
iSEC	-0.0665***	-0.0046***	-0.1992***	-0.0451***
	(0.005)	(0.0004)	(0.0148)	(0.003)
iSEC× RWA$_{t-1}$	0.0893***		0.2659***	
	(0.0065)		(0.0193)	
iSEC×ALLOW$_{t-1}$		0.2939***		0.6885***
		(0.0182)		(0.1716)
Size$_{t-1}$	0.0002***	0.0001**	0.0001	0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Equity$_{t-1}$	0.0232***	0.0187***	0.0052	0.0046
	(0.0026)	(0.0016)	(0.0039)	(0.0044)
Trading_Assets$_{t-1}$	-0.0347***	-0.0062	-0.1497***	-0.0135
	(0.0116)	(0.004)	(0.0395)	(0.014)
Deposits$_{t-1}$	0.002***	0.0013***	0.0224***	0.0147***
	(0.0007)	(0.0003)	(0.0018)	(0.001)
Boone_Ind$_{t-1}$	-0.0089***	-0.0239***	-0.0088***	-0.0733***
	(0.0028)	(0.0015)	(0.0033)	(0.0023)
GDP_Growth$_{t-1}$	0.0005***	0.0005***	0.0007***	0.0007***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
# of Obsevations	77787	77251	77787	77251
# of Banks	2687	2672	2687	2672
# of Instruments	51	51	51	51
AR(1)	0.000	0.000	0.000	0.000
AR(2)	0.586	0.509	0.071	0.139
Hansen Test	0.082	0.201	0.342	0.243

Table 3: **The Impact of Bank Risk on Bank Profitability II.**
This table shows the results of examining the impact of bank risk on bank profitability for securitizer compared to non-securitizer banks over two sub-periods: 2001Q2-2008Q4 and 2009Q1-2017Q4. Model specifications in columns 1 through 8 are estimated using the System-GMM estimation method. The sample in columns 1 through 4 includes quarterly data from 2001Q2 through 2008Q4. The sample in columns 5 through 8 includes quarterly data from 2009Q1 through 2017Q4. *Return_on_Assets* is the return on assets calculated as the ratio of net income to total assets. *Net_Interest_Margin* is the net interest margin calculated as the ratio of net interest income to total assets. *iSEC* is an indicator variable that takes a value of 1 if the bank has securitization activities, and a value of 0 otherwise. *RWA* is the ratio of risk-weighted assets to total assets. *ALLOW* is the ratio of loan loss allowance to total assets. *Size* is the natural logarithm of total assets. *Equity* is the ratio of Tier 1 risk-based capital ratio to total assets. *Trading_Assets* is the ratio of trading assets to total assets. *Deposits* is the ratio of bank deposits to total assets. *Boone_Ind* is the quarterly estimation of Boone indicator for the banking system. *GDP_Growth* is the rate of growth in real gross domestic product. Standard errors in parentheses. *,**,*** denote statistical significance at the 10%, 5%, and 1% level respectively.

	2001Q2-2008Q4				2009Q1-2017Q4			
	Return_on_Assets$_t$		Net_Interest_Margin$_t$		Return_on_Assets$_t$		Net_Interest_Margin$_t$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Return_on_Assets$_{t-1}$	0.3589***	0.4763***			0.4869***	0.4676***		
	(0.0051)	(0.0031)			(0.0047)	(0.005)		
Net_Interest_Margin$_{t-1}$			0.1687***	0.1969***			0.1835***	0.2252***
			(0.0023)	(0.0021)			(0.0015)	(0.0009)
iSEC	-0.1267***	-0.0093***	-0.0038***	-0.0018***	-0.014*	0.0106***	-0.2119***	-0.0006*
	(0.0106)	(0.0007)	(0.0005)	(0.0004)	(0.0072)	(0.0015)	(0.0198)	(0.0003)
iSEC×RWA$_{t-1}$	0.163***		0.896***		0.02**		0.2928***	
	(0.0133)		(0.0676)		(0.01)		(0.027)	
iSEC×ALLOW$_{t-1}$		0.696***		0.6305***		0.2259***		0.3423***
		(0.0279)		(0.0578)		(0 .0216)		(0.024)
Size$_{t-1}$	0.0002**	0.0001	0.0005***	0.0005***	0.0002***	0.0002	0.0004***	0.0001**
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0002)	(0.0001)	(0.0001)
Equity$_{t-1}$	0.0188***	0.01***	0.0143***	0.0192***	0.025***	0.0193***	0.0121*	0.0637***
	(0.0041)	(0.0019)	(0.005)	(0.0052)	(0.0031)	(0.0033)	(0.0067)	(0.0046)
Trading_Assets$_{t-1}$	-0.0802***	-0.0161***	-0.0262***	-0.0302***	-0.0075	0.0075	-0.2052***	-0.0516***
	(0.0193)	(0.0054)	(0.0083)	(0.0087)	(0.0069)	(0.0112)	(0.0273)	(0.0108)
Deposits$_{t-1}$	0.008***	0.001*	0.014***	0.013***	-0.0011*	-0.0027***	0.0134***	0.0044***
	(0.0014)	(0.0005)	(0.0008)	(0.0008)	(0.0006)	(0.0007)	(0.002)	(0.0008)
Boone_Ind$_{t-1}$	0.0257***	0.0032	0.0065**	0.0121***	-0.0427***	-0.0275***	-0.1734***	-0.1378***
	(0.0067)	(0.0034)	(0.0033)	(0.0033)	(0.0057)	(0.0053)	(0.0051)	(0.0021)
GDP_Growth$_{t-1}$	0.0004***	0.0004***	0.0009***	0.0008***	0.0004***	0.0004***	0.0011***	0.0007***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
# of Observations	30321	30102	30321	30102	47466	47149	47466	47149
# of Banks	1783	1772	1783	1772	2144	2131	2144	2131
# of Instruments	29	29	29	29	34	34	34	34
AR(1)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AR(2)	0.432	0.467	0.142	0.113	0.612	0.567	0.093	0.112
Hansen Test	0.071	0.021	0.432	0.321	0.001	0.113	0.231	0.481

holds when using different measures for both bank risk and profitability. Second, there is a decline in the impact of risk on profitability in the period that followed the crisis. For example, A 1% increase in risk-weighted assets after the crisis leads to an increase of 0.02% in return on assets compared to 0.16% before the crisis. This result also holds when using different measures for both bank risk and profitability.

In the second analysis, we examine whether the results hold for different types of securitization activities. To this end, we estimate the model specified in Equation 1 after introducing two different indicator variables instead of $iSEC$. The first indicator variable is $iMBS$ that takes 1 if the bank has outstanding amounts of mortgage-backed securitization, and takes 0 otherwise. The second indicator variable is $iABS$ that takes 1 if the bank has outstanding amounts of asset-backed securitization, and takes 0 otherwise. The results of this specification are reported in Table 4. The results show that the main results presented above still hold for different types of securitization activities. Bank risk significantly and positively affect bank profitability for both mortgage-backed and asset-backed securitizer banks compared to non-mortgage-backed and non-asset-backed securitizer banks, respectively. In addition, the results also show that the impact is larger for asset-backed securitizers compared to mortgage-backed securitizers. For example, a 1% increase in risk-weighted assets leads to an increase of 0.06% in return on assets for mortgage-backed securitizers compared to 0.13% for asset-backed securitizers. These results holds when using different measures for both bank risk and profitability.

4. Can Securitization Explain the Profitability-Risk Trade-off?

The results presented in section 3 establish that, for banks that engage in securitization activities, to increase profitability they should expect to bear more risk. In this section, we extend the analysis to examine whether securitization activities can explain why securitizers encounter this trade-off between profitability and risk. Our strategy of analyzing the role of securitization in explaining this trade-off relies on simultaneously studying two channels through which securitization affects both bank profitability and risk: liquidity and cost of funding.

Table 4: **The Impact of Bank Risk on Bank Profitability III.**
This table shows the results of examining the impact of bank risk on bank profitability for mortgage-backed securitizer compared to non-mortgage-backed securitizer banks and for asset-backed securitizer compared to non-asset-backed securitizer banks. Model specifications in columns 1 through 8 are estimated using the System-GMM estimation method. The sample period includes quarterly data from 2001Q2 through 2017Q4. *Return_on_Assets* is the return on assets calculated as the ratio of net income to total assets. *Net_Interest_Margin* is the net interest margin calculated as the ratio of net interest income to total assets. *iMBS (iABS)* is an indicator variable that takes a value of 1 if the bank has mortgage-backed (asset-backed) securitization activities, and a value of 0 otherwise. *RWA* is the ratio of risk-weighted assets to total assets. *ALLOW* is the ratio of loan loss allowance to total assets. *Size* is the natural logarithm of total assets. *Equity* is the ratio of Tier 1 risk-based capital ratio to total assets. *Trading_Assets* is the ratio of trading assets to total assets. *Deposits* is the ratio of bank deposits to total assets. *Boone_Ind* is the quarterly estimation of Boone indicator for the banking system. *GDP_Growth* is the rate of growth in real gross domestic product. Standard errors in parentheses. *,**,*** denote statistical significance at the 10%, 5%, and 1% level respectively.

	Return_on_Assets$_t$				Net_Interest_Margin$_t$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Return_on_Assets$_{t-1}$	0.5241***	0.512***	0.4699***	0.5185***				
	(0.0023)	(0.0023)	(0.003)	(0.0023)				
Net_Interest_Margin$_{t-1}$					0.2003***	0.2173***	0.1015***	0.1013***
					(0.0013)	(0.0007)	(0.001)	(0.0007)
iMBS	-0.0048***	-0.0091***			-0.2601***	-0.0227***		
	(0.0013)	(0.0016)			(0.0382)	(0.0042)		
iMBS×RWA$_{t-1}$	0.0621***				0.2651***			
	(0.0063)				(0.0526)			
iMBS×ALLOW$_{t-1}$		0.1901***				0.3388***		
		(0.0084)				(0.2973)		
iABS			-0.1051***	-0.0059***			-0.2939***	-0.0721***
			(0.0068)	(0.0006)			(0.0215)	(0.0041)
iABS×RWA$_{t-1}$			0.1317***				0.3567***	
			(0.0081)				(0.0252)	
iABS×ALLOW$_{t-1}$				0.3377***				0.4567***
				(0.0272)				(0.1951)
Size$_{t-1}$	0.0003***	0.0001	0.0001***	0.0002*	0.0003***	0.0001	0.0002*	0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Equity$_{t-1}$	0.0238***	0.0213***	0.0208***	0.0179***	0.0119*	0.039***	0.0031	0.0018
	(0.0023)	(0.0019)	(0.0025)	(0.0016)	(0.0062)	(0.0043)	(0.0036)	(0.0041)
Trading_Assets$_{t-1}$	-0.0021	-0.0034	-0.0408***	-0.0066	-0.1328**	-0.0198***	-0.1465***	-0.0148
	(0.0047)	(0.0026)	(0.0123)	(0.0042)	(0.0544)	(0.006)	(0.0383)	(0.0134)
Deposits$_{t-1}$	0.0013***	0.0019***	0.0015**	0.0016***	0.017***	0.0095***	0.0187***	0.012***
	(0.0003)	(0.0003)	(0.0006)	(0.0003)	(0.0017)	(0.0007)	(0.0016)	(0.001)
Boone_Ind$_{t-1}$	-0.0223***	-0.0133***	-0.0042	-0.0214***	-0.0503***	-0.0715***	-0.0028	-0.0531***
	(0.0015)	(0.0019)	(0.0028)	(0.0015)	(0.0039)	(0.0019)	(0.0032)	(0.0022)
GDP_Growth$_{t-1}$	0.0005***	0.0004***	0.0004***	0.0005***	0.0007***	0.0006***	0.0006***	0.0007***
	(0.0002)	(0.0001)	(0.0001)	(0.0001)	(0.0002)	(0.0001)	(0.0001)	(0.0001)
# of Obsevations	77787	77251	77787	77251	77787	77251	77787	77251
# of Banks	2687	2672	2687	2672	2687	2672	2687	2672
# of Instruments	51	51	51	51	51	51	51	51
AR(1)	0.000	0.002	0.006	0.003	0.001	0.000	0.007	0.000
AR(2)	0.162	0.395	0.167	0,219	0.171	0.432	0.094	0.182
Hansen Test	0.281	0.163	0.404	0.361	0.242	0.387	0.165	0.612

There are various incentives for a bank to engage in securitization activities including improving profitability and improving risk management. While several studies suggest that securitization improves bank profitability (see Kopff and Lent, 1990; Marques-Ibanez and Scheicher, 2012; Thomas, 1999; Wolfe, 2000), the impact of securitization on bank risk is twofold (Instefjord, 2005). On the one hand, it may reduce bank risk by shifting credit risk to the market and improving risk sharing opportunities (Cebenoyan and Strahan, 2004), reducing insolvency risk (Jiangli et al., 2008), or reducing credit risk by securitizing the worst loans while keeping high-quality loans (Mian and Sufi, 2009). On the other hand, securitization may increase bank risk due to the increase in risk taking (Bedendo and Bruno, 2012), recourse and other seller-provided credit enhancements (Higgins and Mason, 2004), or due to retaining riskier loans while selling safer ones in response to regulatory requirements (Ambrose et al., 2005).

We study two channels through which securitization affects both bank risk and profitability. The first channel is bank liquidity. Traditional incentives of securitization entail improving liquidity as a primary objective because securitization allows banks to liquidate illiquid assets and improve liquidity positions (Cardone-Riportella et al., 2010). However, Loutskina (2011) show that when banks have the option to securitize, they tend to reduce their holdings of liquid assets. Similarly, Loutskina and Strahan (2009) show that banks with large amounts of liquid holdings is more expected to grant loans that are difficult to securitize than to grant liquid loans. In other words, banks consider securitization as another source of liquidity that is not counted in the traditional liquidity measures. Liquidity, in turn, impacts both bank profitability and risk. Banks may decide to hold liquid assets to reduce risks and to avoid bank failures (Imbierowicz and Rauch, 2014). Although liquid assets are usually associated with lower rates of return, empirical evidence on the impact of liquidity on bank profitability is ambiguous. While Bourke (1989) and Pasiouras and Kosmidou (2007) show a significantly positive relationship between liquidity and bank profitability, Guru et al. (2002) and Molyneux and Thornton (1992) report an opposite result.

The second channel is cost of funding. Securitization provides banks with an opportunity to diversify funding sources, reduce the costs of external financing through debt and

deposits, and accordingly to reduce the overall cost of funding (Jones, 2000; Pennacchi, 1988). In contrast, some studies suggest that securitizers might encounter higher cost of funding compared to other banks. This occurs when the potential benefits to banks in terms of reduced cost of funding are outweighed by the implicit and explicit costs resulting from recourse related to transactions Higgins and Mason (2004) or when banks provide credit risk enhancements to accompany securitizations (Casu et al., 2013). Cost of Funding, in turn, impacts both bank profitability and risk. Banks with lower need for external funds, have lower cost of funding, lower cost of bankruptcy, and higher profitability (Berger, 1995; Demirgüç-Kunt and Huizinga, 1999). The main argument here is that the availability of securitization as an internal source of funds reduces the sensitivity of the bank cost of funding to the availability of other external sources of funds such as traditional liquid funds and deposits (Loutskina, 2011). This implies that securitization could reduce shocks to cost of funding which leads to lower bank risk.

4.1. Econometric Specification

We argue that securitization activities impact both bank profitability and risk, and that this impact is transmitted through two channels; namely liquidity and cost of funding. To test this argument, we specify a structural model of the bank performance in which profitability, risk, liquidity, and cost of funding are jointly determined in equilibrium, while securitization is exogenous. The model is specified as a system of equations as follows:

$$Y = B\ Y + \Gamma\ X + \zeta \tag{2}$$

where Y is a vector of the endogenous variables: profitability, risk, liquidity, and cost of funding. X is a vector of exogenous variables including securitization. The coefficient matrix B represents the relationships among endogenous variables. The coefficient matrix Γ represents the relationships between endogenous and exogenous variables. ζ is vector of error terms. We estimate the model using two different measures for profitability: net interest margin and return on assets. We also use two different measures for bank risk: the ratio of risk-weighted assets to total assets and the ratio of loan loss allowance to total assets. Liquidity is measured as the ratio of cash and securities to total assets. Cost of funding is estimated as the ratio of interest expense to total assets. Finally, securitization

is estimated as the ratio of outstanding securitization to total assets. For more details on data and variables description, see section 2.2 and Table 1.

We estimate the system of structural equations specified in Equation 2 using the three-stage least square (3SLS) estimation method, which has several advantages over traditional ordinary least squares (OLS) estimation methods (Zellner and Theil, 1962). Given that in our model specification explanatory variables include some endogenous variables, error terms are expected to be correlated with the endogenous variables which violates the assumptions of ordinary least squares (OLS). Further, given that some dependent variables are the explanatory variables of other equations in the system, error terms among the equations are expected to be correlated. Three-stage least squares can correct for these biases given that it can be considered a combination of two-stage least squares (2SLS) and generalized least squares (GLS) (Greene, 2018). It is similar to 2SLS in that it uses an instrumental variable approach to provide consistent estimates and is similar to GLS in that it accounts for the correlation structure in the error terms across the equations.

To estimate a structural model, it is necessary for the model specification to satisfy the identification condition. To solve this identification problem in our model, we use some additional exogenous variables as instruments for endogenous variables in the model. We then estimate the model using the 3SLS estimation method in three stages. In the first stage, instrumented values are developed for all endogenous variables by running regressions of each endogenous variable on all exogenous variables in the system. This stage important to producing consistent parameter estimates and is identical to the first step in 2SLS. In the second stage, the residuals from the 2SLS estimation are used to estimate the covariance matrix of each structural equation. This stage is necessary to obtain consistent estimates for the covariance matrices and correct for the correlation of disturbance among equations. Finally, the structural model is estimated using a GLS estimation in which the endogenous variables are replaced with their estimated values from the first stage of 3SLS and the covariance matrices from the second stage of 3SLS. We then use standard tests in the context of 3SLS to assess our model specification. First, in order to test for the weak instruments problem, we report the F-statistic and the p-value for

each specification to test for the joint relevance of the instruments. We also report the R^2 for each structural equation and the system's McElroy R^2 (McElroy, 1977). Further, to assess the validity of instruments, we use the Hansen-Sargan test for overidentifying restrictions which tests whether the instruments, as a group, appear exogenous (Davidson et al., 2004). We use a vesion of the test that is robust to heteroskedasticity and autocorellation.

Our strategy of analyzing the role of securitization in explaining the profitability-risk trade-off using a simultaneous equations modelling approach has a number of advantages. The main advantage is that it allows us to consider the potential problem of endogeneity given that the system of equations is estimated simultaneously. Another advantage of using this approach is that it allows us to explicitly consider the channels through which securitization affects both bank profitability and risk, and identify the magnitude and direction of the impact. In addition, this approach enables us to decompose the effects of securitization into direct and indirect effects which enables us to compare between these effects and examine how they differ between profitability and risk.

4.2. Empirical Results

Table 5 reports the results of estimating the structural model specified in Equation 2. Each column in the table shows the results of estimating a system of four equations for profitability, risk, liquidity, and cost of funding using securitization as an exogenous variable. To assess the impact of securitization on bank profitability and risk, we focus on the coefficient on securitization in the profitability and risk equations. The results from different specifications show that securitization has a significant and positive impact on both profitability and risk. These results hold through out the full sample period (2001Q2-2017Q4) and the two sample subperiods (2001Q2-2008Q4 and 2009Q1-2017Q4) and using different measures for profitability and risk.

Furthermore, given that all the variables included in the model are scaled by total assets, we can compare the effects of securitization on profitability and risk straightforwardly. Indeed, this comparison yields some interesting findings. The magnitude of the effect of securitization on bank risk is much larger compared to the magnitude of its

effect on bank profitability. For example, a 1% increase in securitization activities leads to 0.77% increase in risk-weighted assets compared to only 0.57% in return on assets for the full sample as shown in column 3. This finding holds for the two subperiods as well as shown in columns 7 and 11. Another interesting finding is that the effect of securitization on profitability is larger when measured by return on assets compared to being measured by net interest margin. This is clear if we consider the two model specifications shown in columns 2 and 4 which are similar except for using return on assets in column 4 instead of net interest margin in column 2. The results show that a 1% increase in securitization leads to 0.42% increase in return on assets compared to only 0.23% increase in net interest margin. This finding applies to risk as well. The effect of securitization on risk is larger when measured by the ratio of risk-weighted assets compared to being measured by the allowance ratio. Considering the two similar specifications in column 1 and 2, a 1% increase in securitization leads to 0.77% increase in risk-weighted assets compared to only 0.39% increase in the allowance ratio. Turning to comparing the effect of securitization in the two subperiods, we notice a decline in the impact of securitization on both profitability and risk in the period that followed the crisis. For example, comparing specifications 8 and 12, we find that a 1% increase in securitization leads to a an increase of 0.54% in return on assets in the first subperiod compared to 0.45% in the second subperiod, and an increase of 0.64% in allowance ratio in the first subperiod compared to 0.38% in the second subperiod.

Overall, the results presented here contribute to explaining our earlier findings on the trade-off between bank profitability and risk for securitizer banks compared to banks that do not engage in securitization activities as shown in section 3. We show that securitization improves bank profitability, but also increases its risk. This implies that for securitizer banks to increase their profitability, they have to bear more risks. The net impact on the bank will determine the contribution of securitization to bank stability. We extend the analysis to study this point in section 5.

4.3. Further Evidence

We extend the analysis presented above to focus on the role played by the two channels through which securitization affects profitability and risk, namely liquidity and cost of

Table 5: **Securitization and Profitability-Risk trade-off.**
This table shows the results of examining the role of securitization in explaining the trade-off between profitability and risk of securitizer banks. Each model specification in columns 1 through 12 is a structural model of four equations for profitability, risk, liquidity, and cost of funding. All specifications are estimated using the three-stage least squares (3SLS) estimation method. The sample period includes quarterly data from 2001Q2 through 2017Q4. *Return_on_Assets* is the return on assets calculated as the ratio of net income to total assets. *Net_Interest_Margin* is the net interest margin calculated as the ratio of net interest income to total assets. *RWA* is the ratio of risk-weighted assets to total assets. *ALLOW* is the ratio of loan loss allowance to total assets. *Cost_of_Funding* is the ratio of interest expense to total assets. *Liquidity* is the ratio of cash and securities to total assets. *Securitization* is the ratio of outstanding securitization amounts to total assets. Standard errors in parentheses. *,**,*** denote statistical significance at the 10%, 5%, and 1% level respectively.

	2001Q2-2017Q4				2001Q2-2008Q4				2009Q1-2017Q4			
	Net_Interest_Margin		Return_on_Assets		Net_Interest_Margin		Return_on_Assets		Net_Interest_Margin		Return_on_Assets	
	RWA	ALLOW	RWA	ALLOW	RWA	ALLOW	RWA	ALLOW	RWA	ALLOW	RWA	ALLOW
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Bank Profitability												
Liquidity_Ratio	-0.0122***	-0.0109***	-0.0013	-0.0010	-0.0158***	-0.0134***	-0.0032***	-0.0015	-0.0056***	-0.0083***	0.0012	0.0017
	(0.001)	(0.0011)	(0.0008)	(0.0008)	(0.0014)	(0.0014)	(0.001)	(0.001)	(0.0017)	(0.0015)	(0.0009)	(0.0011)
Cost_of_Funding	0.6361***	0.6303***	0.1957***	0.1931***	0.7513***	0.7376***	0.1998***	0.1861***	0.8743***	0.9963***	-0.1535***	-0.1754**
	(0.014)	(0.014)	(0.0104)	(0.0104)	(0.0189)	(0.019)	(0.0135)	(0.0135)	(0.0339)	(0.0339)	(0.0256)	(0.0756)
Securitization	0.2311***	0.2323***	0.5711***	0.4214***	0.2441***	0.2463***	0.6891***	0.5401***	0.2153***	0.1869***	0.4254***	0.4470***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0003)	(0.0003)	(0.0002)	(0.0002)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Constant	0.0178***	0.0175***	0.0034***	0.0034***	0.0141***	0.0136***	0.0039***	0.0037***	0.0168***	0.0172***	0.0049***	0.0046***
	(0.0004)	(0.0004)	(0.0003)	(0.0003)	(0.0005)	(0.0005)	(0.0004)	(0.0004)	(0.0005)	(0.0005)	(0.0004)	(0.0004)
Bank Risk												
Liquidity_Ratio	-0.4934***	-0.0014	-0.4821***	-0.0012	-0.5262***	-0.0014	-0.5461***	-0.0016	-0.4481***	-0.0057***	-0.4655***	-0.0061***
	(0.0131)	(0.0012)	(0.0130)	(0.0011)	(0.0196)	(0.0015)	(0.0205)	(0.0015)	(0.0161)	(0.0016)	(0.0151)	(0.0016)
Cost_of_Funding	3.9666***	0.1589***	3.9143***	0.1439***	3.0688***	0.1502***	3.0528***	0.1632***	1.5486***	0.6011***	1.4721***	0.7432***
	(0.1777)	(0.0155)	(0.1732)	(0.0145)	(0.2656)	(0.0202)	(0.3291)	(0.0213)	(0.3786)	(0.0382)	(0.3786)	(0.0382)
Securitization	0.7723***	0.3901***	0.7724***	0.5549***	0.8117***	0.4855***	0.9117***	0.6432***	0.7257***	0.2804***	0.5257***	0.3869***
	(0.0026)	(0.0002)	(0.0026)	(0.0002)	(0.0036)	(0.0003)	(0.0036)	(0.0007)	(0.0038)	(0.0004)	(0.0038)	(0.0004)
Constant	0.8248***	0.0143***	0.8381***	0.0145***	0.8546***	0.0126***	0.8861***	0.0135***	0.8237***	0.0134***	0.6328***	0.0163***
	(0.0044)	(0.0004)	(0.0044)	(0.0003)	(0.0074)	(0.0006)	(0.0081)	(0.0008)	(0.0052)	(0.0005)	(0.0052)	(0.0005)
Liquidity												
Securitization	-0.0141***	-0.0259***	-0.0191***	-0.0346**	-0.0121***	-0.0304***	-0.0221***	-0.0341***	-0.0095**	-0.0101**	-0.0122***	-0.0142***
	(0.0023)	(0.0024)	(0.0031)	(0.0029)	(0.0032)	(0.0036)	(0.0021)	(0.0019)	(0.0034)	(0.0038)	(0.0032)	(0.0036)
Constant	0.2498***	0.2514***	0.1654***	0.1893***	0.2416***	0.2445***	0.2484***	0.2475***	0.2575***	0.2502***	0.2485***	0.2453***
	(0.0011)	(0.0016)	(0.0009)	(0.0016)	(0.0025)	(0.0024)	(0.0022)	(0.0021)	(0.0021)	(0.0023)	(0.0026)	(0.0027)
Cost of Funding												
Securitization	0.0134***	0.0172***	0.0144***	0.0189***	0.0054*	0.0133***	0.0114***	0.0163***	0.0242***	0.0271***	0.0164***	0.01759**
	(0.0021)	(0.0022)	(0.0021)	(0.0028)	(0.0031)	(0.0032)	(0.0032)	(0.0036)	(0.0014)	(0.0015)	(0.0019)	(0.0021)
Constant	0.0112***	0.0111***	0.0109***	0.0110***	0.0167***	0.0166***	0.0154***	0.0125***	0.0061***	0.0061***	0.0061***	0.0061***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
# of Obsevations	7592	7565	7592	7565	3806	3779	3806	3779	3786	3786	3786	3786
# of Instruments	4	4	4	4	4	4	4	4	4	4	4	4
McElroy System R^2	0.535	0.643	0.562	0.532	0.641	0.611	0.632	0.5821	0.432	0.371	0.476	0.429
Hansen-Sargan Test	0.671	0.715	0.276	0.202	0.481	0.283	0.492	0.373	0.112	0.1961	0.118	0.145
F Test [P-value]	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

funding. Given that we follow a simultaneous equations modelling approach to study the effects of securitization on profitability and risk, we exploit an important advantage of this approach. It enables us to decompose the effects of securitization into direct and indirect effects and to compare between these effects and to examine how they differ between profitability and risk. To this end, we rewrite the system of equations 2 in a matrix notation as follows:

$$\begin{bmatrix} y_1 \\ y_2 \\ y_3 \\ y_4 \end{bmatrix} = \begin{bmatrix} \beta_{11} & \beta_{12} & \beta_{13} & \beta_{14} \\ \beta_{21} & \beta_{22} & \beta_{23} & \beta_{24} \\ \beta_{31} & \beta_{32} & \beta_{33} & \beta_{34} \\ \beta_{41} & \beta_{42} & \beta_{43} & \beta_{41} \end{bmatrix} \begin{bmatrix} y_1 \\ y_2 \\ y_3 \\ y_4 \end{bmatrix} + \begin{bmatrix} \gamma_{11} \\ \gamma_{21} \\ \gamma_{31} \\ \gamma_{41} \end{bmatrix} \begin{bmatrix} x_1 \end{bmatrix} + \begin{bmatrix} \zeta_1 \\ \zeta_2 \\ \zeta_3 \\ \zeta_4 \end{bmatrix} \tag{3}$$

where y_1, y_2, y_3, and y_4 denote profitability, risk, liquidity, and cost of funding, respectively. x_1 denotes securitization. A coefficient β_{ij} denotes the coefficient of an endogenous variable i on an endogenous variable j in the i^{th} equation. A coefficient γ_{ij} denotes the coefficient of an endogenous variable i on an exogenous variable j in the i^{th} equation. ζ_i denotes the error terms of the i^{th} equation. For ease of exposition, we present the system of equations with a single exogenous variable x_1 denoting our variable of interest; securitization.

Further, we estimate the system of equations 3 using the three-stage least squares (3SLS) and use the estimated coefficients to calculate the direct, indirect and total effects of securitization on profitability and risk. The direct effects on profitability and risk are simply equal to γ_{11} and γ_{21}, respectively. The indirect effect on profitability is calculated as the effect of securitization on liquidity multiplied by the effect of liquidity on profitability plus the effect of securitization on cost of funding multiplied by the effect of cost of funding on profitability ($\gamma_{31}\beta_{13} + \gamma_{41}\beta_{14}$). Similarly, the indirect effect on risk is calculated as the effect of securitization on liquidity multiplied by the effect of liquidity on risk plus the the effect of securitization on cost of funding multiplied by the effect of cost of funding on risk ($\gamma_{31}\beta_{23} + \gamma_{41}\beta_{24}$). The total effect is calculated as the summation of the direct effect and indirect effect.

The results of this analysis are reported in Table 6. Each column shows the indirect

and total effects of securitization on the profitability and risk measures shown at the top of the column based on estimating the system of equations 3 using these measures. We also report the results of a test of difference between the total effects on profitability and risk at the bottom of each column. In general, the results show that the indirect effect of securitization on profitability is mostly positive except in specifications 11 and 12. Further, this indirect effect is larger in the case of net interest margin compared to return on assets whether in the full sample or in the two subperiods. In the case of risk, the indirect effect is positive in all specifications. This effect is larger in the case of the risk-weighted assets ratio compared to the allowance ratio whether in the full sample or in the two subperiods. Comparing the two subperiods, the results show that the magnitude of indirect effects on net interest margin has increased in the second subperiod (columns 9 and 10) compared to the first one (columns 5 and 6). The opposite is true with return on assets for which the indirect effect has declined in the the second subperiod (columns 11 and 12) compared to the first one (columns 7 and 8). Also, the results show that the magnitude of indirect effects on the allowance ratio has increased in the second subperiod (columns 10 and 12) compared to the first one (columns 6 and 8). This is less clear for the risk-weighted assets ratio for which the indirect effect has increase in one specification (column 9 compared to 5) and decline in the other one (column 11 compared to 7). Turning to the total effects, we notice that it mostly follows the directions and dynamics shown by the direct effect (see Table 5). However, it is worth mentioning that the magnitude of total effects can deviate largely from direct effects due to the addition of indirect effects to reach at total effects. This can be highlighted if we consider column 12 in which the indirect effect is negative with profitability and positive with risk. When adding these indirect effects to direct effects to calculate total effects, we notice that the difference between total effects on profitability and on risk becomes less significant compared to the difference between direct effects on profitability and on risk. This is shown also by the result of the test of difference between total effects reported at the bottom of column 12 which is significant only at the 5% level. Overall, the results presented in this section provide a statistical justification for our modelling approach in which we use a simultaneous equations model to study the simultaneous impact of securitization on both bank profitability and risk. Furthermore, the results highlight the importance of considering liquidity and cost of funding as two channels through which securitization

affects bank profitability and risk.

5. Securitization, Bank Stability, and Systemic Risk

The results presented in Section 3 establish that, for banks that engage in securitization activities, to increase profitability they should expect to bear more risk. In addition, we have extended the analysis in Section 4 to show how engagement in securitization activities can explain this trade-off. In this section, we take the analysis one step further to examine the effects of securitization on bank stability and systemic risk.

5.1. Securitization and Bank Stability

A large number of studies have shown that securitization has had an adverse impact on banks financial soundness and the financial system in general in the run-up to the global financial crisis (Chiesa, 2008; DeMarzo, 2004; Gorton and Pennacchi, 1995; Parlour and Plantin, 2008). In particular, theoretical research shows that securitization may not lead to the expected credit risk diversification. In addition, it could encourage banks to retain the most risky loans, undermine banks' screening and monitoring incentives, and could encourage banks to take more risk.

In contrast, empirical evidence on this issue before the 2008 financial crisis does not uniformly support these arguments. On one hand, some studies show that if banks are securitization active they lend more to risky borrowers (Cebenoyan and Strahan, 2004; Franke and Krahnen, 2007), have less diversified portfolios and hold less capital (Casu et al., 2013), retain riskier loans (Calem and LaCour-Little, 2004), are aggressive in loan pricing (Kara et al., 2011), and carry high risk in general (Affinito and Tagliaferri, 2010; Bannier and Hänsel, 2008). On the other hand, there are studies showing that securitization reduces banks insolvency risk (Jiangli et al., 2008), increases profitability (Cebenoyan and Strahan, 2004), provides liquidity (Loutskina and Strahan, 2009), and leads to greater supply of loans (Altunbas et al., 2009; Loutskina, 2011).

The literature on the effects of securitization post the global financial crisis is also extensive. Most of these studies share the same arguments shown above on the negative consequences of securitization on bank incentives. In particular, securitization has

Table 6: **Decomposing the Effects of Securitization on Profitability and Risk.**
This table shows the results of estimating the indirect and total effects of securitization on profitability and risk. The results presented in each column from 1 through 12 are based on estimates from a structural model of four equations for profitability, risk, liquidity, and cost of funding. All specifications are estimated using the three-stage least squares (3SLS) estimation method. The sample period includes quarterly data from 2001Q2 through 2017Q4. *Return_on_Assets* is the return on assets calculated as the ratio of net income to total assets.*Net_Interest_Margin* is the net interest margin calculated as the ratio of net interest income to total assets. *RWA* is the ratio of risk-weighted assets to total assets. *ALLOW* is the ratio of loan loss allowance to total assets. *Profitability* and *Risk* represent the measures used for profitability and risk in each column, respectively. Standard errors in parentheses. *,**,*** denote statistical significance at the 10%, 5%, and 1% level respectively.

	2001Q2-2017Q4				2001Q2-2008Q4				2009Q1-2017Q4			
	Net_Interest_Margin		Return_on_Assets		Net_Interest_Margin		Return_on_Assets		Net_Interest_Margin		Return_on_Assets	
	RWA	ALLOW	RWA	ALLOW	RWA	ALLOW	RWA	ALLOW	RWA	ALLOW	RWA	ALLOW
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Indirect Effects of Securitization on:												
Profitability	0.0087***	0.0111***	0.0028***	0.0037***	0.0042***	0.0102***	0.0023***	0.0031***	0.0212***	0.0271***	-0.0025***	-0.0031***
	(0.0011)	(0.0012)	(0.0004)	(0.0004)	(0.0017)	(0.0018)	(0.0005)	(0.0006)	(0.0017)	(0.0017)	(0.0003)	(0.0003)
Risk	0.0601***	0.0028***	0.0656***	0.0028***	0.0229***	0.0020***	0.0469***	0.0027***	0.0417***	0.0163***	0.0298***	0.0131***
	(0.0135)	(0.0005)	(0.0135)	(0.0005)	(0.0172)	(0.0006)	(0.0172)	(0.0006)	(0.0173)	(0.0001)	(0.0173)	(0.0001)
Total Effects of Securitization on:												
Profitability	0.2398***	0.2434***	0.5739***	0.4251***	0.2483***	0.2565***	0.6914***	0.5432***	0.2365***	0.2140***	0.4229***	0.4439***
	(0.0023)	(0.0025)	(0.0016)	(0.0016)	(0.0031)	(0.0033)	(0.0019)	(0.0002)	(0.0038)	(0.0038)	(0.0026)	(0.0026)
Risk	0.8324***	0.3929***	0.838***	0.5577***	0.8346***	0.4875***	0.9586***	0.6459***	0.7674***	0.2967***	0.5555***	0.4000***
	(0.0093)	(0.0024)	(0.0293)	(0.0024)	(0.0396)	(0.0029)	(0.0396)	(0.0029)	(0.0414)	(0.0039)	(0.0414)	(0.0039)
Test of Difference Between TotalEffects												
F Test [P-value]	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0112	0.0000	0.0401

been under scrutiny for fuelling credit growth by banks, lowering banks' credit standards and creating a false sense of diversification of risks. In other words, being one of the main causes of the financial crisis (Kara et al., 2011). Shin (2009) provides a theoretical framework showing how securitization may impair financial stability if the imperative to expand bank balance sheets drives down lending standards. Others (Benmelech et al., 2012; Casu et al., 2011; Shivdasani and Wang, 2011) do not find a link between bank risk taking and securitization.

Furthermore, the regulatory response post the crisis has aimed at addressing these flaws in the securitization market. The efforts have been concentrated on promoting responsible securitization through measures aiming to align interest between issuer banks and investors. Second, regulators have focused on reducing information asymmetries between the counterparties by improving transparency on underlying assets and the asset-backed structure and to support accurate pricing of credit risk. In this direction, some regulatory incentives from the European Central Bank (ECB) have introduced loan-level information requirements for ABSs if used as collateral in the Eurosystem's credit operations. Recent ECB initiatives also aim to identify qualifying securitizations, which through their simplicity, structural robustness and transparency, would enable investors to model risk with confidence and would provide originators with incentives to behave responsibly (Mersch, 2017). This can help reduce the negative impact of securitization on bank stability.

Our strategy of analyzing the impact of securitization on bank stability relies on adjusting our structural model of the bank performance presented above to account for risk-adjusted profitability as a function of securitization activities, instead of considering profitability and risk separately. This model also accounts for the two channels through which securitization affects both bank stability: liquidity and cost of funding. Based on this model, we construct and analyse the dynamics of a measure of the net effect of securitization on bank stability.

5.1.1. Econometric Specifications

Our analysis has focused so far on the effects of securitization on bank profitability and risk. Estimating these effects separately, however, is not sufficient to assess the impact

of securitization on bank stability. Therefore, there is a need for a measure that captures the impact on both profitability and risk simultaneously and in turn the impact on bank stability. To address this issue we construct a measure of risk-adjusted profitability for each bank as follows:

$$RAP_{i,t} = PROFIT_{i,t} - RISK_{i,t} \tag{4}$$

where $RAP_{i,t}$, $PROFIT_{i,t}$, and $RISK_{i,t}$ denote risk-adjusted profitability, profitability, and risk of bank i at time t. The rationale behind this measure is that securitization activities can affect both profitability and risk either positively or negatively, but from a stability perspective it is the net effect that matters. In other words, if $RAP_{i,t}$ is positive (negative), the effect of securitization on bank stability is said to be positive (negative). Further, to ensure consistency between profitability and risk measures, we calculate $RAP_{i,t}$ in two different methods. In the first, we use return on assets as a measure of profitability and the ratio of risk-weighted assets as a measure of risk in order to focus on the overall performance of the bank. In the second method, we use net interest margin as a measure of profitability and the allowance ratio as a measure of risk in order to focus on the loan portfolio of the bank. In addition, to ensure comparability all measures of profitability and risk are scaled by total assets.

Next, we adjust the model presented in section 4 to specify a structural model of the bank stability in which risk-adjusted profitability, liquidity, and cost of funding are jointly determined in equilibrium, while securitization is exogenous. The model is specified as a system of equations as follows:

$$Y = B\ Y + \Gamma\ X + \zeta \tag{5}$$

where Y is a vector of the endogenous variables: risk-adjusted profitability, liquidity, and cost of funding. X is a vector of exogenous variables including securitization. The coefficient matrix B represents the relationships among endogenous variables. The coefficient matrix Γ represents the relationships between endogenous and exogenous variables. ζ is vector of error terms. We estimate the model using the risk-adjusted profitability measure as shown in Equation 4. Liquidity is measured as the ratio of cash and securities to total assets. Cost of funding is estimated as the ratio of interest expense to

total assets. Finally, securitization is estimated as the ratio of outstanding securitization to total assets. For more details on data and variables description, see section 2.2 and Table 1. In addition, we estimate the model using the three-stage least squares (3SLS) estimation method and report the standard specification and overidentification tests. For more details on the estimation method, see section 4.

Furthermore, rewriting the system of equations 5 in a matrix notation yields:

$$\begin{bmatrix} y_1 \\ y_2 \\ y_3 \end{bmatrix} = \begin{bmatrix} \beta_{11} & \beta_{12} & \beta_{13} \\ \beta_{21} & \beta_{22} & \beta_{23} \\ \beta_{31} & \beta_{32} & \beta_{33} \end{bmatrix} \begin{bmatrix} y_1 \\ y_2 \\ y_3 \end{bmatrix} + \begin{bmatrix} \gamma_{11} \\ \gamma_{21} \\ \gamma_{31} \end{bmatrix} \begin{bmatrix} x_1 \end{bmatrix} + \begin{bmatrix} \zeta_1 \\ \zeta_2 \\ \zeta_3 \end{bmatrix} \tag{6}$$

where y_1, y_2, and y_3 denote risk-adjusted profitability, liquidity, and cost of funding, respectively. x_1 denotes securitization. A coefficient β_{ij} denotes the coefficient of an endogenous variable i on an endogenous variable j in the i^{th} equation. A coefficient γ_{ij} denotes the coefficient of an endogenous variable i on an exogenous variable j in the i^{th} equation. ζ_i denotes the error terms of the i^{th} equation. For ease of exposition, we present the system of equations with a single exogenous variable x_1 denoting our variable of interest; securitization.

Finally, we use the estimated coefficients from the system of equations 6 to calculate the direct, indirect and total effects of securitization on risk-adjusted profitability as shown in section 4. We then construct a measure of bank stability which is defined as the sensitivity of the bank risk-adjusted profitability to changes in securitization activities. This measure can be estimated using the estimated direct and indirect effects of securitization on risk-adjusted profitability as follows:

$$S\text{–}score = \frac{d\ RAP}{d\ SEC} = \gamma_{11} + \gamma_{21}\beta_{12} + \gamma_{31}\beta_{13} \tag{7}$$

where $S\text{–}score$ is a measure of the impact of securitization on bank stability. $\frac{d\ RAP}{d\ SEC}$ is the total derivative of risk-adjusted profitability with respect to securitization. The terms γ_{11} and $\gamma_{21}\beta_{12} + \gamma_{31}\beta_{13}$ represent the direct and indirect effects of securitization on risk-adjusted profitability, respectively.

5.1.2. Empirical Results

The results of estimating the structural model specified in Equation 5 are reported in Table 7. Each column in the table shows the results of estimating a system of three equations for risk-adjusted profitability, liquidity, and cost of funding using securitization as an exogenous variable. To assess the impact of securitization on bank stability, we focus on the coefficient on securitization in the risk-adjusted profitability equation. The results from different specifications show that securitization significantly and negatively affects bank stability. These results hold when using different measures for risk-adjusted profitability and through out the full sample period (2001Q2-2017Q4) and the two sample subperiods (2001Q2-2008Q4 and 2009Q1-2017Q4). Nevertheless, the magnitude of this decline depends on how risk-adjusted profitability is measured. In particular, the effect is larger when using return on assets and risk-weighted assets ratio to calculate risk-adjusted profitability (-0.16%, -0.24%, -0.09% in columns 1, 3, and 5) compared to using net interest margin and the allowance ratio (-0.20%, -0.22%, -0.10% in columns 2, 4, and 6). This implies that the impact is larger when using measures of overall bank profitability and risk as compared to focusing on the loans portfolio, which is in line with our earlier results on the effect of securitization on profitability and risk. Turning to comparing the effect of securitization in the two subperiods, we can notice an interesting finding. There is a decline in the effects of securitization on risk-adjusted profitability in the period that followed the crisis. For example, comparing specifications 3 and 5, we find that a 1% increase in securitization leads to a decline of 0.23% in risk-adjusted profitability in the first subperiod compared to 0.09% in the second subperiod.

Further, we report the results of examining the effects of securitization on bank stability in Table 8. Each column shows the direct and indirect effects of securitization on risk-adjusted profitability based on estimating the system of equations 5. In addition, for each specification, we report *S–score* which is our proposed measure of the impact of securitization on bank stability. Comparing the results across specifications yields some interesting findings. Regarding the indirect effect of securitization on stability, the results show that it is positive when focusing on the loans portfolio (columns 1, 3, and 5), but turns negative when focusing on the overall performance of the bank (columns 2, 4, and 6). This contradiction is due to the opposite effect of liquidity and cost of funding on

risk-adjusted profitability when measured at the loans portfolio level as compared to the overall balance sheet level (see Table 7). In addition, this indirect effect is larger in the case of measuring risk-adjusted profitability at the loans portfolio level as compared to the overall balance sheet level. Turning to the *S–score* measure, we notice that it is negative across specifications. For instance, in the full sample, a 1% increase in securitization is associated with an *S–score* of -0.14% at the loans portfolio level and -0.25% at the overall balance sheet level. This Implies that the net impact of securitization on bank stability is negative. In addition, comparing the *S–score* measure between the two subperiods shows that its magnitude is larger in the first subperiod (columns 3 and 4) compared to the second subperiod (columns 5 and 6).

Overall, the results presented here extend our earlier findings on the positive effect of securitization on both bank profitability and risk for securitizer banks compared to banks that do not engage in securitization activities as shown in Section 4. We have taken the analysis one step further to examine the effects of securitization on bank stability. Our results show that securitization activities are destabilizing. The net impact of securitization on banks is generally negative when we measure the bank performance based on risk-adjusted profitability measures. This impact is negative whether at the loans portfolio level or the overall balance sheet level. This destabilizing effect is more significant in the period that led to the global financial crisis in 2008 compared to the period that followed the crisis. Nevertheless, our analysis is silent so far on why these results are different before and after the global financial crisis. In Section 6, we put forward an explanation for this difference.

5.1.3. Further Evidence

To further highlight the dynamics of *S–score* over time, we estimate the structural model specified in Equation 5 using a twelve-quarters rolling-window of data over the full sample period from 2001Q2 through 2017Q4. We then calculate *S–score* using the estimated coefficients as shown by Equation 6 for each quarter from 2004Q2 through 2017Q4. We estimate *S–score* in two ways. The first is at the loan portfolio level using net interest margin as a measure of bank profitability and the allowance ratio as a measure of the riskiness of the loan portfolio. The second is at the overall balalnce sheet level

Table 7: **Securitization and Risk-Adjusted Profitability.**
This table shows the results of examining the effects of securitization on Risk-Adjusted Profitability. Each model specification in columns 1 through 6 is a structural model of three equations for risk-adjusted profitability, liquidity, and cost of funding. All specifications are estimated using the three-stage least squares (3SLS) estimation method. The sample period includes quarterly data from 2001Q2 through 2017Q4. *NIM−ALLOW* is the risk-adjusted profitability calculated using net interest margin to measure profitability and the allowance ratio to measure risk. *ROA−RWA* is the risk-adjusted profitability calculated using return on assets to measure profitability and the risk-weighted assets ratio to measure risk. *Liquidity* is the ratio of cash and securities to total assets. *Cost_of_Funding* is the ratio of interest expense to total assets. *Securitization* is the ratio of outstanding securitization amounts to total assets. Standard errors in parentheses. *,**,*** denote statistical significance at the 10%, 5%, and 1% level respectively.

	Risk-Adjusted Profitability					
	2001Q2-2017Q4		2001Q2-2008Q4		2009Q1-2017Q4	
	NIM−ALLOW	ROA−RWA	NIM−ALLOW	ROA−RWA	NIM−ALLOW	ROA−RWA
	(1)	(2)	(3)	(4)	(5)	(6)
Risk-Adjusted Profitability						
Liquidity	-0.0125***	0.4935***	-0.0121***	0.5249***	-0.0141***	0.4503***
	(0.0013)	(0.1304)	(0.0017)	(0.1924)	(0.0019)	(0.1681)
Cost_of_Funding	0.4489***	-3.6872***	0.5504***	-2.7556***	0.3914***	-1.7177***
	(0.0169)	(0.2726)	(0.0225)	(0.2582)	(0.0260)	(0.3772)
Securitization	-0.1578***	-0.2013***	-0.2392***	-0.2226***	-0.0935**	-0.1003*
	(0.0271)	(0.0256)	(0.0323)	(0.0348)	(0.0467)	(0.0574)
Constant	-0.3543***	-0.8224***	-0.3832**	-0.8526***	-0.4132***	-0.8189***
	(0.0632)	(0.0838)	(0.0641)	(0.0724)	(0.0643)	(0.0821)
Liquidity						
Securitization	-0.0254***	-0.0136***	-0.0292***	-0.0115***	-0.0241***	-0.0141***
	(0.0023)	(0.0022)	(0.0031)	(0.0029)	(0.0038)	(0.0028)
Constant	0.2511***	0.2495***	0.2541***	0.2413***	0.2575***	0.2465***
	(0.0161)	(0.0163)	(0.0024)	(0.0026)	(0.0023)	(0.0027)
Cost of Funding						
Securitization	0.0192***	0.0141***	0.0142***	0.0132***	0.0243*	0.0171***
	(0.0018)	(0.0017)	(0.0023)	(0.0021)	(0.0016)	(0.0014)
Constant	0.0114***	0.0115***	0.0171***	0.0148***	0.0161**	0.0152**
	(0.0012)	(0.0014)	(0.0021)	(0.0018)	(0.0071)	(0.0062)
# of Obsevations	7708	7736	3922	3950	3786	3786
# of Instruments	4	4	4	4	4	4
McElroy System R^2	0.538	0.655	0.573	0.725	0.453	0.517
Hansen-Sargan Test	0.345	0.421	0.525	0.432	0.124	0.234
F Test [P-value]	0.000	0.000	0.000	0.000	0.000	0.000

Table 8: **Securitization and Bank Stability.**
This table shows the results of estimating the direct, and indirect effects of securitization on risk-adjusted profitability and constructing *S–score* as a measure of the impact of securitization on bank stability. The results presented in each column from 1 through 6 are based on estimates from a structural model of three equations for risk-adjusted profitability, liquidity, and cost of funding. All specifications are estimated using the three-stage least squares (3SLS) estimation method. The sample period includes quarterly data from 2001Q2 through 2017Q4. *NIM–ALLOW* is the risk-adjusted profitability calculated using net interest margin to measure profitability and the allowance ratio to measure risk. *ROA–RWA* is the risk-adjusted profitability calculated using return on assets to measure profitability and the risk-weighted assets ratio to measure risk. *S–score* measures the impact of securitization on bank stability. Standard errors in parentheses. *,**,*** denote statistical significance at the 10%, 5%, and 1% level respectively.

	2001Q2-2017Q4		2001Q2-2008Q4		2009Q1-2017Q4	
	NIM–ALLOW	ROA–RWA	NIM–ALLOW	ROA–RWA	NIM–ALLOW	ROA–RWA
	(1)	(2)	(3)	(4)	(5)	(6)
Bank Stability						
Direct Effect	-0.1578***	-0.2013***	-0.2392***	-0.2226***	-0.0935**	-0.1003*
	(0.0018)	(0.0017)	(0.0023)	(0.0021)	(0.0016)	(0.0014)
Indirect Effect	0.0089***	-0.0587***	0.0082***	-0.0424***	0.0099***	-0.0357***
	(0.0010)	(0.0130)	(0.0014)	(0.0164)	(0.0009)	(0.0174)
S–score	-0.1489***	-0.2593***	-0.231***	-0.2646***	-0.0836*	-0.1353**
	(0.0281)	(0.0285)	(0.0351)	(0.0383)	(0.0501)	(0.0581)

using return on assets as a measure of profitability and the ratio of risk-weighted assets as a measure of the riskiness of total assets.

The results of this exercise are shown in Figure 3. Panels (A) and (B) show the estimated *S–score* at the loan portfolio and balance sheet levels, respectively. Interestingly, the dynamics shown in both panels are very similar. The *S–score* is negative during most of the quarters. Both panels also show that the destabilizing impact of securitization is more severe in the run-up to the global financial crisis, where it bottoms out in 2010Q4. However, it is worth noting that the three-years window of data used for estimation implies that the lowest values for the *S–score* are actually based on data mostly from the period of the global financial crisis. Following the crisis, the destabilizing effect seems to have declined. Nevertheless, none of the two estimates of *S–score* show any significant positive effects of securitization on bank stability, even in the aftermath of the global financial crisis.

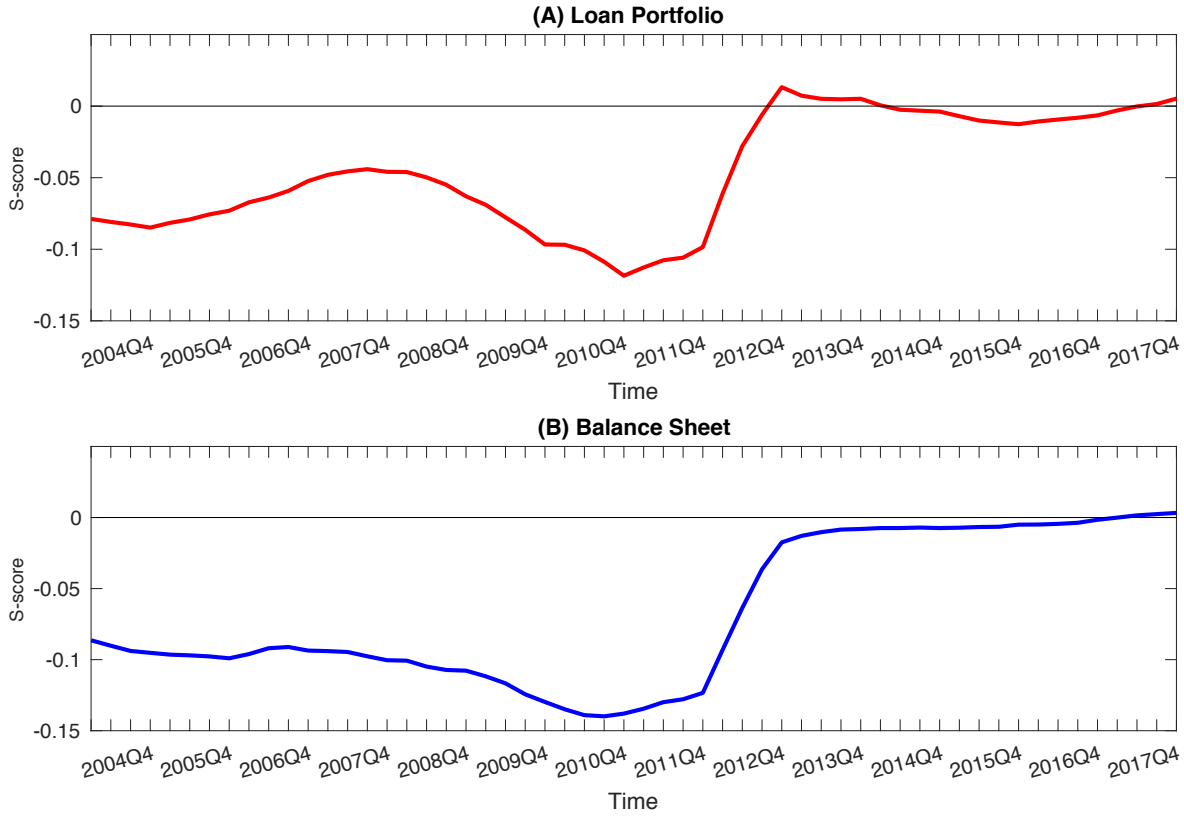

Figure 3: *S–score*: **A Measure of the Impact of Securitization on Bank Stability.** Panel (A) shows estimated *S–score* at the loan portfolio level. Panel (B) shows estimated *S–score* at the overall balance sheet level.

5.2. Securitization and Systemic Risk

Our strategy of analyzing the impact of securitization on systemic risk at the banking system level relies on evaluating the commonality among banks returns from securitization activities as an indicator of interconnectedness and systemic risk.

5.2.1. Econometric Specifications

Our analysis has focused so far on the effects of securitization at the bank level. Estimating these effects, however, is not sufficient to gauge the systemic effects of securitization. Therefore, to address this issue, we measure the commonality among the returns from securitization activities of banks as an indicator of the systemic effects of securitization activities. Our main argument here is that increased commonality among the asset returns of banks is an indicator of increased systemic risk (Battiston et al., 2012; Caccioli et al., 2015). To identify this commonality, we use the measure suggested by Billio et al. (2012) based on principal components analysis (PCA) to capture the changes in commonality among the returns from securitization activities of banks. PCA

is a technique in which the asset returns of financial institutions can be decomposed into orthogonal components of decreasing explanatory power (Jackson, 2005).

Formally, let R^i be the return from securitization of bank i, $i = 1, ..., N$, let $E[R^i] = \mu_i$, and let $Var[R^i] = \sigma_i^2$. Further, let the system's aggregate return from securitization be $R^S = \sum_i R^i$, and let $Var[R^S] = \sigma_S^2$. It then follows that:

$$\sigma_S^2 = \sum_{i=1}^{N} \sum_{j=1}^{N} \sigma_i \sigma_j E[z_i z_j] \tag{8}$$

where z is standardized return from securitization. The PCA decomposes the variance-covariance matrix of returns from securitization of the N banks into an orthonormal matrix of loadings $L = \{L_{ik}\}$ which represents the eigenvectors of the correlation matrix of returns, and a diagonal matrix $\Lambda = \{\Lambda_k\}$ which represents eigenvalues. Equation 8 can then be written as:

$$\sigma_S^2 = \sum_{i=1}^{N} \sum_{j=1}^{N} \sum_{k=1}^{N} \sigma_i \sigma_j l_{ik} l_{jk} \lambda_k \tag{9}$$

where λ_k denotes principal components, $k = 1, ..., N$.

It is expected that the first few components will explain most of the volatility in the system. In addition, they capture a larger portion of the total volatility when returns tend to move together which is often associated with crisis periods. Therefore, we analyze the systemic effects of securitization by examining the portion of volatility in return from securitization activities that is explained by the first few principal components. An increase in this portion is indicative of increased commonality in returns from securitization activities and increased interconnectedness among banks, and accordingly higher systemic risk.

5.2.2. Empirical Results

We apply the PCA using data on net securitization income of individual banks over the period 2001Q2-2017Q4. We use rolling windows of twelve quarters of data to construct a time series of principal components and cumulative risk fractions. The results of this analysis are shown in Figure 4 and summary statistics are reported in Table 9. The time series graph of principal components shows that the first six principal components (PC1,

PC2-3, and PC4-6) capture the majority of variation in net securitization income over the full sample period. Nevertheless, the relative importance of these groups of PCs varies considerably. In particular, Figure 4 shows that PC1 is very dynamic, capturing from 27% to 42% of variation in net securitization income. The PC1 was already high from the beginning of the sample period and started to increase from 2005Q4 in the run-up to the global financial crisis, peaking at 42% in 2008Q4. It then declined in the aftermath of the crisis bottoming out at 27% in 2017Q1. On average, the PC1 explains 36% of the variation in net securitization income in the period that preceded the global financial crisis compared to 31% in the period that followed the crisis. This implies that securitization activities have contributed to increasing interconnectedness among banks in the run-up to the global financial crisis, hence increasing systemic risk in the banking system.

In addition, Table 9 reports the principal components and cumulative risk fractions for five selected time periods: 2004Q1-2006Q4, 2006Q1-2008Q4, 2009Q1-2011Q4, 20012Q1-2014Q4, and 2014Q1-2017Q4. As shown by the Cumulative Risk Fractions, the first six principal components capture 92%, 93%, 88%, 89%, and 88% of the variability in net securitization income among banks in these five time periods, respectively. On average, the first six (three) principal components explain 90% (59%) of this variability. Further, the first principal component explains 34% of the variability in net securitization income, on average. Interestingly, the first principal component explains 42% in the period from 2006Q1 through 2008Q1, which is the highest compared to all other time periods. Overall, comparing these five periods confirms our results above that securitization activities have contributed more to the increasing interconnectedness among banks in the run-up to the global financial crisis and increased systemic risk in the banking system.

6. The Role of Monetary Policy

The results presented in Section 4 show that securitization activities improve bank profitability, but also increase its risk. Further investigation in Section 5 shows that securitization activities have negative impact on bank stability and systemic risk. An interesting finding in both cases is that the effects of securitization on either profitability, risk, stability, or systemic risk differ significantly between the period from 2001Q2

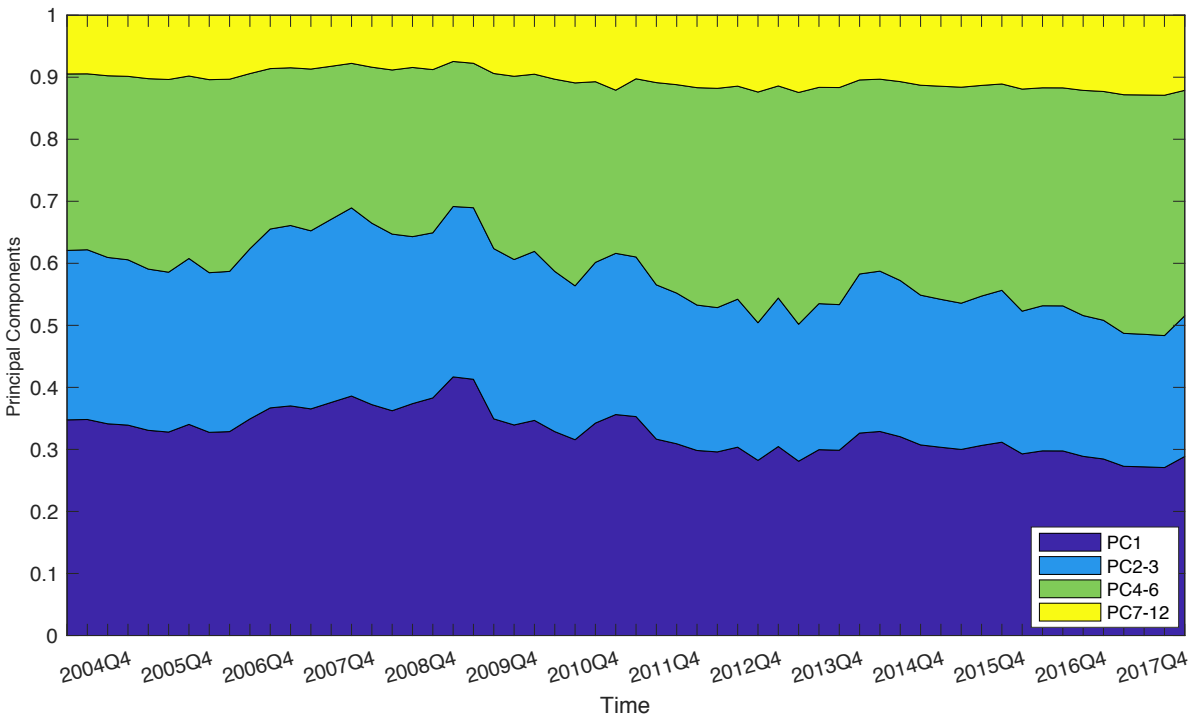

Figure 4: **Results of Principal Components Analysis**
This figure presents the principal components grouped into four groups including PC1, PC2-3, PC4-6, and PC-12. Estimates are based on a 12-quarters rolling-window principal components analysis of the quarterly standardized net securitization income of individual banks over the sample period 2001Q2-2017Q4.

through 2008Q1 which preceded the global financial crisis, compared to the period from 2009Q1 through 2017Q4 which followed the crisis. So far, our analysis has been silent on why these results are different. In this section, we put forward an explanation for this difference.

We argue that the decline in monetary policy short-term interest rates has mitigated the destabilizing impact of securitization on banks following the onset of the global financial crisis. This can be justified on the basis that a decline in monetary policy rates would encourage banks to rely more on traditional funding sources compared to securitization. Banks would then be selective regarding which loans to grant, and which loans to securitize. This would eventually reduce risk taking by banks in their securitization activities and reduce its destabilizing effect. We put this argument to test using an identification strategy centred around an exogenous monetary policy shock following the global financial crisis. Specifically, we evaluate whether the destabilizing impact of securitization has changed around the dramatic decline in short-term interest rates following the onset of

Table 9: **Results of Principal Components Analysis**
This table reports summary statistics for Principal Components including PC1, PC2-3, PC4-6, and Cumulative Risk Fractions including PC1, PC1-3, PC1-6. Statistics are based on the quarterly standardized net securitization income of individual banks over the sample period 2001Q2-2017Q4. Minimum, mean and maximum values are reported for three sample periods: 2001Q1-2017Q4, 2001Q1-2008Q4, and 2009Q1-2017Q4. Principal components and cumulative risk fractions are reported for five selected time periods: 2004Q1-2006Q4, 2006Q1-2008Q4, 2009Q1-2011Q4, 20012Q1-2014Q4, and 2014Q1-2017Q4.

		Principal Components			Cumulative Risk Fraction		
		PC1	PC2-3	PC4-6	PC1	PC1-3	PC1-6
Main Sample Periods							
2004Q1-2017Q4							
	Min	27%	21%	23%	27%	48%	87%
	Mean	33%	25%	31%	33%	58%	89%
	Max	42%	30%	39%	42%	69%	93%
2004Q1-2008Q4							
	Min	33%	26%	23%	33%	58%	90%
	Mean	36%	28%	28%	36%	63%	91%
	Max	42%	30%	31%	42%	69%	93%
2009Q1-2017Q4							
	Min	27%	21%	23%	27%	48%	87%
	Mean	31%	24%	33%	31%	55%	89%
	Max	41%	28%	39%	41%	69%	92%
Selected Time Periods							
2004Q1-2006Q4		37%	29%	25%	37%	66%	92%
2006Q1-2008Q4		42%	27%	23%	42%	69%	93%
2009Q1-2011Q4		30%	23%	35%	30%	53%	88%
2012Q1-2014Q4		30%	24%	34%	30%	54%	89%
2015Q1-2017Q4		29%	23%	36%	29%	52%	88%

the global financial crisis, that might have affected bank incentives to securitize loans.

6.1. Econometric Specifications

As discussed above, we are interested in studying the role of short term interest rates in mitigating or worsening the impact of securitization activities on bank stability. Therefore, to analyse how the net impact of securitization activities depends on monetary policy interest rates, we follow Duchin et al. (2010) and employ a difference-in-differences (DID) approach with a continuous treatment variable (monetary policy interest rates). More specifically, we compare the change in *S–score* of banks before and after the decline in federal funds rate following the onset of the global financial crisis. To this end, we estimate the following regression specification:

$$\Delta S\text{–}score_{i,t} = \alpha_i + \beta_1\, iPOST + \beta_2\, iPOST \times FED_t + \gamma\, \mathbf{X}_{i,t} + \theta_t + \varepsilon_{i,t} \qquad (10)$$

where $\Delta S{-}score$ denotes the change in the impact of securitization on bank stability, $iPOST$ is an indicator variable equal to one for every quarter after and including 2009Q1, and zero before that, FED is the end of quarter effective federal funds rate, $\mathbf{X}$ is a vector of control variables, θ is a time-specific effect, and ε is the error term. In this specification, we specifically focus on the coefficient β_2 which captures the decrease in the destabilising effect of securitization in the low interest rate era. It is expected to be positive to reflect the improvement in *S–score* with the decline in fed funds rate. We estimate *S–score* for individual banks based on the structural model specified in Equation 5 and based on a twelve-quarters rolling-window of data over the period from 2001Q2 through 2017Q4.

To estimate our difference-in-differences model, we use a window of eight years of data from 2005Q1 through 2012Q4, surrounding the severe decline in federal funds rates at the fourth quarter of 2008 following the onset of the global financial crisis. In addition, we use a bank-specific fixed effects estimation method with time dummies included to control for time-fixed effects and heteroskedasticity-consistent standard errors clustered at the bank level following (Bertrand et al., 2004).

6.2. Empirical Results

Table 10 presents estimates of the difference-in-differences specification described above. We use two measures for individual banks *S–score*. The first is related to the loan portfolio and estimated based on net interest margin and the allowance ratio, and the second is related to the overall balance sheet of the bank and estimated based on return on assets and the ratio of risk-weighted assets. The coefficients of interest are the coefficient on the exogenous monetary policy shock dummy and the coefficient on the interaction between this dummy and federal funds rate. The positive value of these coefficients indicate a decline in the destabilizing effect of securitization activities during the low interest rate era.

Column 1 of Table 10 establishes the main pattern in the data. It shows that *S–score* measured at loan portfolio level has improved by 2.88% by the average bank in the low interest rate period. The magnitude of this improvement is supported by our previous estimates of *S–score* at the banking system level as shown in Section 5. Column 2 shows

that this improvement is substantially greater when considering the impact of the exogenous monetary policy shock. The coefficient estimate implies that, on average, *S–score* has improved by 3.53%, which increases to 5.23% when considering the decline in federal funds rate. Further, controlling for bank heterogeneity in column 3 shows that the estimated coefficients on the monetary policy dummy variable and its interaction with federal funds rate remain statistically significant and further increase in magnitude.

Turning to the impact of monetary policy change on *S–score* measured at the overall balance sheet level, we notice similar pattern to that described above at the loan portfolio level. Column 4 of Table 10 shows that *S–score* measured at the balance sheet level has improved by 1.37% by the average bank in the low interest rate period. The magnitude of this improvement is supported by our previous estimates of *S–score* at the banking system level as shown in Section 5. Column 5 shows that this improvement is substantially greater when considering the impact of the exogenous monetary policy shock. The coefficient estimate implies that, on average, *S–score* has improved by 1.52%, which increases to 3.23% when considering the decline in federal funds rate. Further, controlling for bank heterogeneity in column 6 shows that the estimated coefficients on the monetary policy dummy variable and its interaction with federal funds rate remain statistically significant and further increase in magnitude.

Overall, the results support the mitigating role of low interest rates on the net impact of securitization on bank stability as measured by *S–score*. It is also worth noting that the magnitude of improvement in the this destabilizing impact is higher when measured at the loan portfolio level compared to being measured at the overall balance sheet level. This implies that mitigating effects of low interest rates has been higher at the loan portfolio level, which is supported by our earlier findings shown in Section 5.

6.3. Further Evidence

In response to the global financial crisis, several regulatory initiatives were enacted which brought about several structural changes into the banking industry and securitization markets. Examples include the Housing and Economic Recovery Act of 2008, the Dodd-Frank Act of 2010, as well as the unconventionally low monetary policy short-

term interest rates. This implies that the effect of monetary policy interest rates could be commingled with the effects of other policy initiatives that coincided with monetary policy decline following the global financial crisis. Therefore, to check the robustness of our results from the difference-in-differences analysis presented above, we conduct an additional test in which we examine the impact of monetary policy interest rates on the return from and riskiness of securitization activities. This approach has the added benefit of explicitly considering the direct impact of monetary policy interest rates on the profitability and riskiness of securitization activities, which translates into the effects of securitization on bank stability.

We measure return from securitization activities by the ratio of net securitization income to total assets $NSIOA$. Both values are obtained from call reports of individual banks. Whereas, riskiness of securitization is measured using an adjusted version of the Altman $Z\text{–}score$ (Altman, 1968) calculated based on securitization activities as follows:

$$Z\text{–}score_{i,t} = \frac{NSIOA_{i,t} + Equity_{i,t}}{\sigma_{NSIOA_{i,t}}}$$

where $Z\text{–}score$, $NSIOA$, $Equity$, and σ_{NSIOA} are the adjusted $Z\text{–}score$, the ratio of net securitization income to total assets, the ratio of equity capital to total assets, and the standard deviation of net securitization income, respectively. Indices i and t denote banks and time, respectively. We estimate $\sigma_{NSIOA_{i,t}}$ based on a twelve-quarters rolling-window of the ratio of net securitization income to total assets.

Next, we estimate the following regression specification for return from securitization activities:

$$\Delta NSIOA_{i,t} = \alpha_i + \beta_1 \, \Delta NSIOA_{i,t-1} + \beta_2 \, FED_{t-1} + \gamma \, \mathbf{X}_{i,t-1} + \theta_t + \varepsilon_{i,t} \qquad (11)$$

and the following regression specification for riskiness of securitization activities:

$$\Delta Z\text{–}score_{i,t} = \alpha_i + \beta_1 \, \Delta Z\text{–}score_{i,t-1} + \beta_2 \, FED_{t-1} + \gamma \, \mathbf{X}_{i,t-1} + \theta_t + \varepsilon_{i,t} \qquad (12)$$

where FED is federal funds rate, $\mathbf{X}_{i,t}$ is a vector of control variables, θ_t is time-specific

fixed effect, and $\varepsilon_{i,t}$ is an error term. In addition, we estimate these specifications using the system generalized method of moments (System-GMM) estimation method and report the standard specification and overidentification tests. For more details on the estimation method, see Section 3. The data sample used to estimate these specification is quarterly data from 2004Q2 through 2017Q4.

The results from estimating specifications 11 and 12 are presented in Table 11, which provides estimates over three sample periods: 2004Q2-2017Q4, 2004Q2-2008Q4, 2009Q1-2017Q4. Columns 1, 2, and 3 show the results of evaluating the impact of monetary policy interest rates on the return from securitization activities. The coefficient on fed funds rate is positive and significant throughout the sample period, which matches our expectations. Column 1 shows that a 100 basis point increase in fed funds rate leads to an increase in the ratio of net securitization income of 2.62%, on average. Interestingly, the magnitude of this impact is different when comparing between the two subperiods 2004Q-2008Q4 and 2009Q1-2017Q4. On average, a 100 basis point increase in fed funds rate leads to an increase in the ratio of net securitization income of 3.62% in the first subperiod, whereas the magnitude of this change declines in the second subperiod to 1.47% only.

Furthermore, Columns 4, 5, and 6 of Table 11 show the results of evaluating the impact of monetary policy interest rates on the riskiness of securitization activities. The coefficient on fed funds rate is positive and significant in the full sample and first sample subperiod, but negative in the second subperiod. Column 4 shows that a 100 basis point increase in fed funds rate leads to an increase in the adjusted Z-score of 1.19% in the full sample period, on average. Whereas, in the first subperiod (column 5), a 100 basis point increase in fed funds rate leads to an increase in the adjusted Z-score of 1.93%. Interestingly, the magnitude of this impact drops significantly in the second subperiod. Column 6 show that, on average, a 100 basis point increase in fed funds rate leads to an increase in the the adjusted Z-score of only 0.096% in the second subperiod.

Overall, the results presented here support our previous evidence that the decline in monetary policy rates in the period that followed the global financial crisis has con-

Table 10: **Results on the Role of Monetary Policy I.**
This table reports the results from a difference-in-differences analysis of the role of monetary policy in mitigating the impact of securitization on bank stability. All specifications 1 through 6 are fixed effects regressions. The sample period includes an eight-year window of quarterly data from 2005Q1 through 2012Q4. $\Delta S\text{–}score$ is the change in the impact of securitization on bank stability. $NIM\text{–}ALLOW$ indicates that $S\text{–}score$ is estimated using net interest margin as a measure profitability and the allowance ratio as a measure risk. $ROA\text{–}RWA$ indicates that $S\text{–}score$ is estimated using return on assets to measure profitability and the risk-weighted assets ratio to measure risk. $iPOST$ is an indicator variable for the low interest rate period that is equal to 1 in quarters after and including 2009Q1, and 0 otherwise. *FED* is end-of-quarter effective federal funds rate. *Size* is the natural logarithm of total assets. *Equity* is the ratio of Tier 1 risk-based capital ratio to total assets. Standard errors in parentheses. *,**,*** denote statistical significance at the 10%, 5%, and 1% level respectively.

	$\Delta S\text{–}score$					
	NIM–ALLOW			ROA–RWA		
	(1)	(2)	(3)	(4)	(5)	(6)
iPOST	2.883***	3.241***	3.532***	1.371***	1.515***	1.539***
	(0.732)	(0.864)	(0.917)	(0.045)	(0.049)	(0.061)
iPOST×FED		5.234***	5.554***		3.217***	3.456**
		(1.345)	(1.427)		(1.141)	(1.262)
Size			-1.134*			-2.181**
			(0.625)			(1.104)
Equity			8.261**			5.766**
			(4.418)			(2.745)
Constant	-2.468***	-4.189***	-9.311***	-0.498***	-0.311***	-14.875***
	0.701	0.946	3.843	0.132	0.112	2.765
# of Observations	3,338	3,338	3,338	3,339	3,339	3,339
Adjusted R^2	0.072	0.094	0.132	0.083	0.103	0.121
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes

tributed to mitigating the destabilizing impact of securitization. On the one hand, our results show that changes fed funds rates have positively affected both profitability and riskiness of securitization activities in the run-up to and the period that followed the global financial crisis. On the other hand, the results show that the magnitude of this impact declines significantly in the period that followed the crisis, with a more dramatic decline in the case of riskiness of securitization activities. Put together, these findings lead us to conclude that the decline in monetary policy interest rates have worked to mitigate the destabilizing impact of securitization in the aftermath of the global financial crisis.

Table 11: **Results on the Role of Monetary Policy II.**
This table reports the results of evaluating the impact of monetary policy interest rates on the return and riskiness of securitization activities. Model specifications in columns 1 through 6 are estimated using the System-GMM estimation method. The sample includes quarterly data and estimates are provided for the full sample; 2004Q2-2017Q4 and for two subsamples: 2004Q2-2008Q4, and 2009Q1-2017Q4. $\Delta NSIOA$ is the change in the ratio of net securitization income to total assets. Δ *Z-score* is the change in the adjusted Z-score estimated based on the ratio of net securitization income to total assets of individual banks. *FED* is the end-of-quarter effective federal funds rate. *Size* is the natural logarithm of total assets. *Equity* is the ratio of Tier 1 risk-based capital ratio to total assets. *Trading_Assets* is the ratio of trading assets to total assets. *Deposits* is the ratio of bank deposits to total assets. Standard errors in parentheses. *,**,*** denote statistical significance at the 10%, 5%, and 1% level respectively.

	Δ NSIOA			Δ Z-score		
	2004Q2-2017Q4	2004Q2-2008Q4	2009Q1-2017Q4	2004Q2-2017Q4	2004Q2-2008Q4	2009Q1-2017Q4
	(1)	(2)	(3)	(4)	(5)	(6)
Δ NSIOA$_{t-1}$	0.110***	0.124***	0.069***			
	(0.0027)	(0.0021)	(0.0073)			
Δ Z-score$_{t-1}$				0.154***	0.189***	0.155***
				(0.0341)	(0.0452)	(0.0118)
FED$_{t-1}$	2.618***	3.621***	1.471**	1.192**	1.929***	-0.861**
	(0.0019)	(0.0074)	(0.7226)	(0.5871)	(0.6301)	(0.416)
Size$_{t-1}$	0.479*	1.226*	0.109	0.038***	0.021***	0.006
	(0.2714)	(0.6531)	(0.1761)	(0.0053)	(0.0013)	(0.0256)
Equity$_{t-1}$	21.75***	23.49***	12.130***	-0.492***	-0.453***	-0.249**
	(0.0151)	(0.1951)	(0.135)	(0.0180)	(0.0296)	(0.1110)
Trading_Assets$_{t-1}$	-3.769**	-6.20***	-5.88**	0.456	1.873*	3.118**
	(1.7660)	(3.212)	(2.456)	(1.0689)	(1.1051)	(1.516)
Deposits$_{t-1}$	8.146***	5.68*	1.353***	-0.045***	-0.120***	-0.038
	(4.0079)	(3.3814)	(0.0716)	(0.0065)	(0.0069)	(0.0478)
# of Observations	1,743	1,231	512	756	448	308
# of Banks	113	96	46	52	43	30
# of Instruments	20	20	20	20	20	20
AR(1)	0.147	0.150	0.008	0.049	0.006	0.111
AR(2)	0.455	0.424	0.431	0.871	0.143	0.876
Hansen Test	0.582	0.734	0.606	0.307	0.773	0.171

7. Conclusion

This paper considers the effects of securitization on bank performance and stability. We examine how securitization affects both bank profitability and risk and how these effects in turn determine the net impact of securitization on bank stability and further on systemic risk at the banking system level. In particular, we develop a structural model that consists of a system of simultaneous equations and models bank performance and stability as a function of securitization activities. This approach enables us to simultaneously consider the effects of securitization on bank profitability, risk and stability, while accounting for the two main channels through which securitization affects profitability and risk, namely liquidity and cost of funding.

We find that there is a trade-off between profitability and risk of banks that engage in securitization activities. The results also show that securitization activities can explain this trade-off given that securitization improves profitability but at the expense of increasing bank risk taking. Furthermore, we propose *S–score* as a measure of the net exposure of banks to securitization activities. Analysis of the dynamics of this measure show that securitization activities have destabilizing effect on securitizer banks. Further analysis explains the role of monetary policy in mitigating the destabilizing effect of securitization on banks in the period that followed the global financial crisis.

There have been several attempts to revive securitization markets to boost banking efficiency and risk sharing in capital markets (Mersch, 2017). These attempts require a deep revision of the securitization effects on both banks and financial markets to avoid any unintended consequences for bank performance and stability. Our paper provides a framework for regulators to think about the effects of securitization at the bank level and the banking system level. It is important that regulators consider the effects of securitization on a risk-adjusted performance basis, and to consider the different channels through which securitization affects bank performance and stability.

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