Implications of securitisation on bank performance: evidence from US commercial banks

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Abstract: A key financial innovation used widely in banking is the process of securitisation. Using data on all 5491 commercial banks in the USA that were operational between 2001 2nd quarter to 2016 1st quarter, the present study examines the impact of both aggregate securitisation activity and its underlying asset categories on bank profitability, leverage capital, diversification and risks. Aggregate securitisation and that of asset-backed securities as well as its constituent categories of commercial & industrial (C&I) loans and other loans significantly increase banks' profits. Securitisation significantly increase banks leverage capital and diversification activities, including net securitisation income. Finally, we find securitisation activities to reduce banks credit risks but increase default risk in the post-crisis period.

Keywords: securitisation; US commercial banking; profitability; leverage capital; diversification; bank risks.

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Biographical notes: Amit Ghosh is an Associate Professor of Economics at Illinois Wesleyan. He received his PhD from Claremont Graduate University, and works mainly in the areas of open-economy macroeconomics, international finance, and banking. Till date he has published more than 30 journal articles on the topics of 'exchange-rate regimes', 'banking sector globalisation', 'non-performing loans', 'bank failures', 'policy trilemma', etc. His current research includes analysing the impact of innovation and deregulation in the US banking industry and the implications of different aspects of banking on entrepreneurship.

1 Introduction

A conspicuous financial innovation used widely in banking is the phenomenon of securitisation. This process typically involves transformation of illiquid assets like mortgages, auto loans, credit card receivables, home equity loans etc. into liquid assets and marketable securities that are sold in the secondary market. Traditionally banks originated illiquid loans and funded them with liquid deposits. With securitisation the real

projects still remain illiquid, but the loans have become more liquid as banks securitise them. The process involves bundling together the cash flows from some illiquid assets like mortgages and then selling the pool to a separate legal entity known as a special purpose vehicle (SPV). The pooling process results in a diversified portfolio of cash flows, which are used to support payments on debt securities issued by the SPV. Often the cash flows come with some additional implicit or explicit guarantees from the originating financial institution (or the originator retains the residual or equity tranche in the SPV).[1] Cash flows from the original pool of loans can be further stripped and repackaged based on various characteristics (e.g., the prepayment behaviour or payment priority) to enhance their liquidity (Loutskina and Strahan, 2009; Uzun and Webb, 2007).

Some of the benefits of securitisation for banks include reducing information asymmetries; increasing financial slack; serving as a low cost financing resource; reducing regulatory capital; lowering bank risks and liquidity needs (Greenbaum and Thakor, 1987; Hess and Smith, 1988). In rebuttal, one can alternatively argue that securitisation simply creates screening or monitoring disincentives (Gorton and Pennacchi, 1995; Keys et al., 2010, 2012), leading to portfolio illiquidity (Loutskina, 2011), and incentivises more risk taking (Casu et al., 2011; Hansel and Krahnen, 2007; Kara et al., 2016) by banks.

However, securitisation was under deep scrutiny in the wake of the recent global financial crisis (henceforth GFC) as excessive securitisation of sub-prime mortgages, and the subsequent meltdown of these assets with the downturn of the housing sector, has been pointed as one of the key reasons for the recent financial crisis in the USA. Consequently, this has sparked huge interest in academic research in analysing different aspects of securitisation.

Reducing risks and increasing stability in the banking system is an overarching goal of bank regulators. However, to achieve this first requires a deeper understanding of the implications of securitisation. In this context, using a very comprehensive database on all 5491 commercial banks in the USA that were operational over the period 2001Q2 to 2016Q1, the present study provides fresh evidence on the effect of securitisation activities on banks' profits, leverage capital and diversification. Additionally, we also revisit the impact of securitisation on banks credit and insolvency risks. The extant literature on securitisation mostly covers the period before the financial crisis. By encapsulating data till the first quarter of 2016, we also examine the extent to which the impact of securitisation on different facets of banking may have changed since the crisis. Unlike previous literature that mainly uses aggregate securitisation activities, this study scrutinises both aggregate and disaggregated categories of securitisation. Such sector-specific analysis of securitisation can not only unmask important differences in how they affect banks' performance but also help banks mitigate risks arising from specific types of securitisation activities they engage in. Previewing the results, securitisation significantly increases banks profits, leverage capital and diversification. It also reduces banks credit risks but increases insolvency risks.

The rest of this paper proceeds as follows. Section 2 provides a succinct survey on the recent empirical literature on securitisation activities by banks in the USA. Section 3 presents some trends and patterns of securitisation in the US banking industry. Section 4 estimates the impact of securitisation on bank profits, leverage capital and diversification. Section 5 examines the same on banks credit and insolvency risks. Finally, Section 6 discusses the policy implications of this analysis.

2 Survey of the recent literature.

Existing literature has focused on the causes of securitisation (Thomas and Wang, 2004; Vickery, 2007) or how it can be designed to overcome informational asymmetries associated with credit risk (DeMarzo, 2005; Gorton and Souleles, 2005; Morrison, 2005; Parlour and Plantin, 2008) or as a risk management strategy (van Oordt, 2014). A second strand of literature focuses on examining the impact of securitisation on loan growth and funding management (Cebenoyan and Strahan, 2004; Goderis et al., 2007; Hirtle, 2007; Loutskina, 2011). Yet, other studies concentrate both theoretically and empirically on the impact of securitisation on banks risk profile (Dionne and Harchaoui, 2003; Krahnen and Wilde, 2006; Uzun and Webb, 2007).

The impact of securitisation might vary across different countries due to existing differences in accounting standards and regulatory practices. Thus our survey of impact studies is confined to banks in the USA only. Using a sample of 112 banks over the period 2001–2005 Uzun and Webb (2007) find securitisation activities to reduce bank's total risk-based capital ratio, a result that is driven by credit card securitisations. However, securitisation of mortgages and home equity loans actually increase banks' capital ratio. Using quarterly data on US bank holding companies (henceforth BHCs) for the period 2001–2007, Casu et al. (2011) find a greater share of securitised assets to reduce banks credit risk, a result that is primarily driven by securitisation of mortgages and home equity lines of credit (HEL). Following on the heels of this study, Casu et al. (2013) use data on 336 US commercial banks for the period 2002–2008, but do not find any significant impact of securitisation on bank profits. However, securitisation significantly reduces banks non-performing loans, and hence credit risks. Using data on US BHCs for the period 2001–2007, Jiangli and Pritsker (2008), find securitisation of mortgages, HEL and C&I loans reduce banks insolvency risks while securitised credit card loans increase such risks. Securitisation is also found to significantly increase bank's profits.

More recently, Chen et al. (2017) using data on a sample of US commercial banks from 2002 to 2012, find securitisation to significantly reduce insolvency risk as measured by bank z-score but increases the likelihood of bank failure, indicating a short-term risk reduction and a long-term risk increase effect. In a related study, Bord and Santos (2015) using data on US banks find corporate loans that are securitised are more likely to default than loans that are not securitised. Cebenoyan and Strahan (2004) find banks in the USA active in securitising loans have lower credit risk and higher profits for the period 1987–1993.

3 Trends and patterns in securitisation

3.1 Measuring securitisation

Since June 2001, banks in the USA are required to provide detailed information on their securitisation activities in their regulatory form Y-9C that are filed on a quarterly basis. The incorporation of the new data into FR Y-9C determines the starting date of the sample period. For all other banks' balance sheet data we use the publicly available

Reports of Condition and Income database (commonly called Call Report Files). These files contain quarterly bank-level balance sheet information for all banks regulated by the Federal Reserve System, Federal Deposit Insurance Corporation, and the Comptroller of the Currency. We use data on all 5491 commercial banks that were functional over this 15 year span using their unique identifying code with the Federal Reserve for all 64 quarters.

Outstanding principal balances on securitisation activities are available for seven categories:

- 1–4 family residential loans (i.e., mortgages)
- home equity lines (HEL)
- credit card receivables
- auto loans
- all other consumer loans
- commercial & industrial (C&I) loans
- all other types of loans.[2]

Aggregate securitisation activity (SA_{jt}) by a bank (say, j) in quarter t is measured as the sum of these seven securitised categories.

$$SA_{jt} = \frac{\sum_{i=1}^{7} sa_i}{TA_{jt}} \tag{1}$$

where sa_i denotes the outstanding principal balance on securitisation activity in sector i, TA denotes total assets of bank j in quarter t. We also categorise asset-backed securities (henceforth ABS) as the sum of all these categories excluding mortgages, relative to total assets.

$$\text{ABS}_{jt} = \frac{\sum_{i=2}^{7} sa_i}{TA_{jt}} \tag{2}$$

Sector-specific securitisation activities of a bank are measured as the share of securitised assets relative to total loans in that same category.

3.2 Trends and patterns

Figure 1 shows the evolution of overall securitisation activities by all banks combined. We observe a steady rise in securitised assets reaching the highest value of $1.54 billion in 2008Q4 followed by a decline to $1.07 billion in the next quarter and then a subsequent rise to $1.51 billion in 2009Q2. After the real estate burst and the meltdown of the US economy, we see a decline in overall securitisation by banks from 2009 onwards. At the end of March 2016, overall securitised assets stood at $799 billion rising from $442 billion at the beginning of the century.

Figure 2 next shows the decomposition of overall securitisation activities into its constituent categories based on their average holding by banks from 2001Q2-2016Q1. Over this time period, mortgage securitisation (henceforth MBS) comprised 75% of overall securitisation by banks, followed by credit cards (12%) and all other loans (10%).

Figure 1 Total securitised assets (see online version for colours)

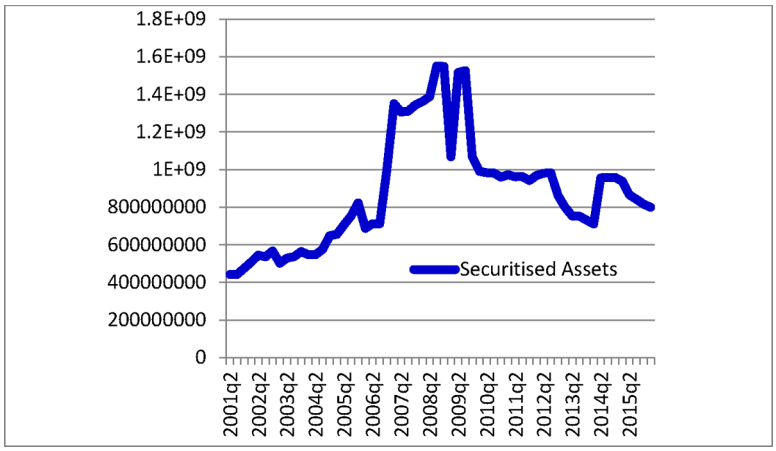
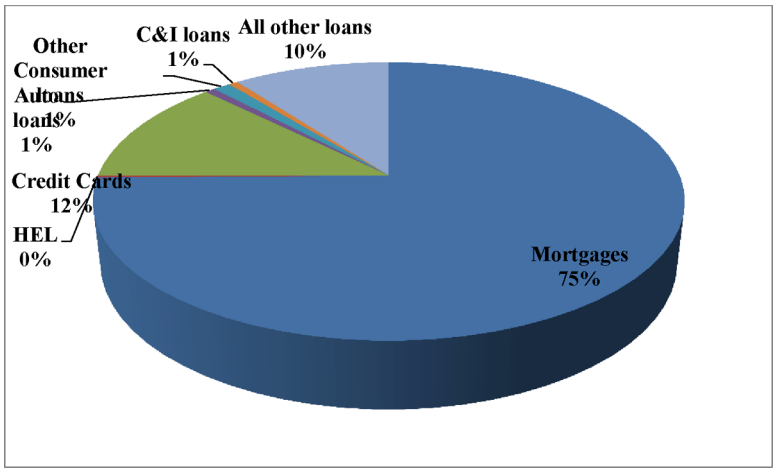


Figure 2 Decomposition of securitised assets 2001–2016 (see online version for colours)



Figures 3 and 4 show the patterns of securitisation at the disaggregated level. Figure 3 plots both MBS and ABS, respectively. An ocular view clearly reveals that MBS dominates all other categories combined, and its time path closely mirrors that of overall securitisation. The financial innovation of securitisation greatly garnered momentum in the period leading to the real estate market crash in the USA. This applies not only for securitisation of mortgages (MBS) but for other categories of securitisation as well. Especially, notice worthy is the steep rise in MBS from 2005 to 2008 during the build-up off the housing market boom, followed by a precipitous decline. With the bust of the real estate bubble and the consequent decline in value of MBS, securitisation activities declined not only for residential mortgages but for all other categories as well. This

explains the decline in the post-crisis period for both MBS and ABS with MBS still exceeding ABS. At the end of the sample-period of study (March 2016), the extent of MBS stood at $704 billion. Figure 4 presents the pattern for different categories of ABS. The graph reveals two distinct patterns. First, till 2009, all other loans exhibits a steady increase and then shows a decline post-crisis, much like overall securitisation and MBS. Secondly, from 2001 to 2009, securitisation of credit card receivables was the dominant category of ABS. However, securitisations of credit cards also plummet in the wake of the crisis. Securitisation of auto and C&I loans remain the two smallest categories over the period of study.

Figure 3 Time path of MBS and ABS (see online version for colours)

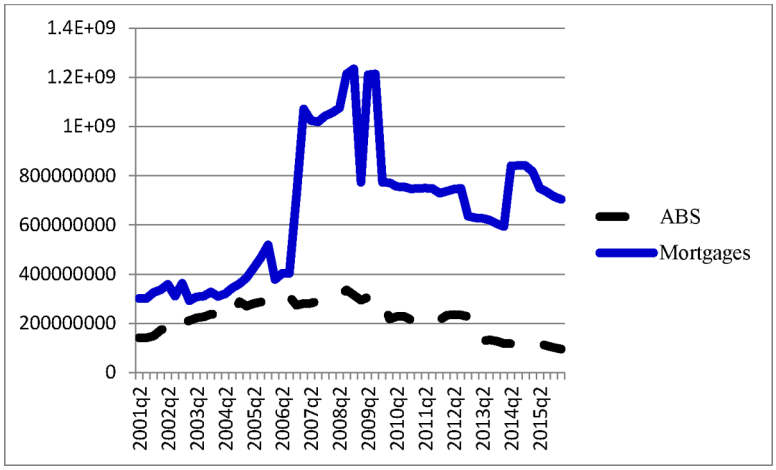


Figure 4 Time series of different categories of ABS (see online version for colours)

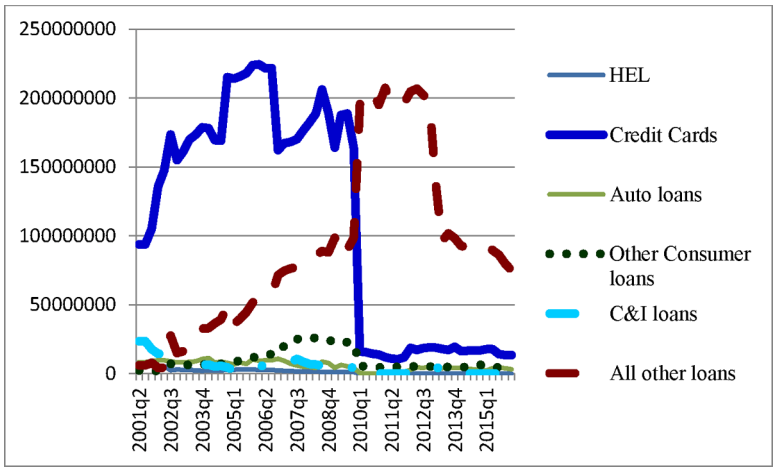


Table 1 identifies the top dozen banks with the highest average share of both overall securitised assets (as a percent of total assets) and MBS (as a percent of total real estate loans), respectively. Clearly, American Express Bank emerges as the bank with the highest portfolio of securitised assets.

Table 1 Top banks holding securitised assets

Rank	*Overall securitisation*		*Mortgage securitisation*	
1	American Express Centurion Bank	67.984%	American Express Centurion Bank	51.602%
2	Discover Bank	66.600%	Wells Fargo Bank, National Association	31.128%
3	Wells Fargo Bank, National Association	54.798%	The Huntington National Bank	6.391%
4	SunTrust Bank	43.650%	JPMorgan Chase Bank	6.369%
5	First Tennessee Bank, National Association	39.195%	Bank of America, National Association	5.938%
6	Chase Manhattan Bank USA, National Association	38.017%	TCF National Bank	2.589%
7	MidFirst Bank	34.330%	East-West Bank	1.769%
8	Banco Popular de Puerto Rico	26.546%	KeyBank National Association	1.744%
9	Third Federal Savings and Loan Association of Cleveland	25.202%	Manufacturers and Traders Trust Company	1.699%
10	First National Bank of Omaha	20.130%	Hibernia National Bank	1.681%
11	Citibank, National Association	15.187%	USAA Federal Savings Bank	1.596%
12	Manufacturers and Traders Trust Company	14.499%	PNC Bank, National Association	0.761%

Table 2 presents the summary statistics of the different categories of securitisation activities as well as other variables used in the ensuing econometric analyses in sections 4 and 5. For a comparative analysis, the statistics are provided for the pre- (2001–2006) and the post-crises (2007–2016) periods. The share of MBS exhibits the highest standard deviation indicating the volatile nature of securitised real estate loans. This is especially accentuated in the post-crisis period. For the other balance sheet variables, liquidity risk is most volatile in the pre-crisis period while in the post-crisis era loans-to-assets ratio exhibits the highest gyration.

Table 2 Summary statistics

Securitisation variables	μ	σ *pre-crisis*	*n*	μ	σ *post-crisis*	*n*
Securitisation share	0.006	0.235	113,889	0.003	0.074	192,623
MBS share	0.089	8.224	112,371	0.151	32.431	189,841
ABS share	0.005	0.234	113,893	0.001	0.054	192,623
HEL share			0	0.000	0.006	105,322
Credit card share	0.050	1.056	32,195	0.049	6.967	43,038
Auto share			0	0.000	0.007	98,687
Other consumer share	0.000	0.010	112,073	0.001	0.063	187,854
Other loans share	0.000	0.016	110,947	0.000	0.024	186,677
C&I share	0.011	1.608	99,503	0.110	12.494	166,092

Table 2 Summary statistics (continued)

Dependent variables	*μ*	*σ pre-crisis*	*n*	*μ*	*σ post-crisis*	*N*
Credit risk	0.778	19.562	126,086	0.655	0.141	202,834
NPL	0.068	7.363	122,574	0.039	2.134	201,876
z-score	33.038	22.056	126,086	33.563	22.949	202,834
Insolvency risk	0.013	1.966	125,375	0.006	0.679	201,757
Leverage capital-to-average assets	11.006	6.237	126,086	11.085	6.005	202,834
Return on assets	1.161	2.077	126,086	0.929	3.309	202,834
Diversification	0.166	0.154	126,084	0.166	0.291	202,820
Net securitisation income-to-assets	0.000	0.007	113,709	0.000	0.003	192,292
Other banking variables	*μ*	*σ pre-crisis*	*n*	*μ*	*σ post-crisis*	*n*
Bank size	11.696	1.295	126,293	12.138	1.376	203,167
Total equity capital-to-assets	11.297	6.295	126,086	11.533	6.167	202,834
Loans-to-assets	0.776	2.848	126,293	0.989	46.332	203,087
Charge-off rate	0.010	1.882	125,370	0.005	0.613	201,757
Credit quality	0.013	1.966	125,375	0.006	0.679	201,757
Liquidity risk	0.421	19.604	126,293	0.312	0.166	203,167
Overhead costs-to-assets	0.023	0.097	126,086	0.020	0.041	202,834
Funding costs	0.046	4.118	126,075	0.052	5.436	202,834
ΔLog (Deposits)	0.018	0.227	120,786	0.012	0.091	203,167
US macro variables	*μ*	*σ pre-crisis*	*n*	*μ*	*σ post-crisis*	*n*
real GDP growth	0.663	0.421	126,293	0.311	0.665	203,167
Log (Inflation)	–0.802	0.788	120,802	–0.848	0.692	181,203
Log (Prime loan rate)	0.054	0.014	126,293	0.039	0.014	203,167
ΔLog (HPI)	0.018	0.007	126,293	–0.001	0.014	203,167
Term premium	1.949	1.252	126,293	2.240	0.876	203,167

μ – mean, σ – standard deviation, n – number of observations.

4 Impact of securitisation on banks' profits, leverage capital and diversification

4.1 Securitisation and bank profits

The effect of securitisation on bank profits is theoretically ambiguous. On the one hand, securitisation gives banks more options to fund its activities, and managing its risk profile. All else equal, expanded opportunities should lead to greater expected profits. It also enables banks to diversify portfolios, enhance funding of both ongoing operations, increasing investments, and hence bank profits (Affinito and Tagliaferri, 2010). In rebuttal, securitisation could lower the profits of banks through many indirect channels. For example, if securitisation leads to more competition in originating securitisable loans, it may depress banks' spreads in originating those types of loans;

thereby reducing banks' profits (see Instefjord, 2005). As such the impact of securitisation on bank profits is essentially an empirical question.

The influence of securitisation on bank profits is estimated using a fixed effects model:

$$\pi_{it} = a_{0it} + a_{jit}\,(X^{j}_{it-1}) + a_{kit}\,(X^{k}_{it-1}) + \mu_i + \lambda_t + \varepsilon_{it} \tag{3}$$

where π_{it} denotes profits in bank i in quarter t; (X^{j}_{it-1}) denotes a vector of bank specific variables; (X^{k}_{it-1}) represents a vector of macroeconomic variables. μ refers to bank fixed effects to control for unobserved heterogeneity across banks, λ is time fixed effects (i.e., quarterly dummies) to capture the regulatory and development changes in the US banking industry over time and ε_{it} is an independently and identically distributed error term. The fixed effects estimation further allows the unobserved bank specifics to be arbitrarily correlated with the determinants of bank profitability, and under the assumption of strict exogeneity it also takes into account bank-specific differences. We use robust standard errors clustered at the bank level to control for dependence of errors for a given bank over time. All explanatory variables are lagged by one quarter to minimise any potential endogeneity issues.

Following the literature on bank profitability (Dietrich and Wanzenried, 2014), X^{j}_{it-1} include bank equity capital-to-assets, credit quality, diversification, liquidity risk, overhead costs-to-assets (OCA), funding costs, size and deposit growth. Bank profits (π_{it}) are measured as return on assets (ROA), defined as net income after tax as a percent of average total assets.[3] Credit quality is measured by provision for loan losses-to-total loans. The share of non-interest income to total income measures diversification. Liquidity risk is measured by sum of cash and investment securities-to-total assets while funding costs are measured as the ratio of interest expenses to total deposits. OCA is defined as non-interest expenses divided by total assets. Size is measured by the logarithmic value of total assets of a bank. Higher capitalisation and diversification are expected to increase bank profits, while increases in credit quality, liquidity risk, OCA and funding costs will apriori lower profits. The impacts of bank size and deposit growth are theoretically ambiguous.

X^{k}_{it-1} denote real GDP growth, log of inflation, log of bank prime loan rate, and changes in housing price index (HPI). Increases in these macro-financial controls are expected to increase bank profits.

The first column of Table 3 unveils that aggregate securitisation activities significantly increase bank profits. This illustrates the key reason for banks to engage in securitisation and explains its enormous growth. The results are similar to the findings of Cebenoyan and Strahan (2004), Jiangli and Pritsker (2008) and illustrate that securitisation offer banks an efficient way of lowering banks' cost of financing and enhancing profits. Columns 2 and 3 show the results for MBS, and ABS, respectively, while Columns 4–9 show the same for the other sector-specific securitisation activities. MBS is statistically insignificant but ABS significantly increases profits. The same applies for its two constituent categories of other loans and C&I loans. The lack of significance of MBS is consistent with the findings of Casu et al. (2013) indicating that mortgage securitisation encourages banks to take on more risk and reduce their incentives to carefully monitor loans. On the other side, non-mortgage securitisation activities (ABS) require banks to provide higher retention of risk exposures that forces

them to continue monitoring such loans. Within ABS, only other consumer loans reduce bank profits. Other categories of individual loans, like loans for household, family and other personal expenditures such as home improvement, education etc. may be difficult to securitise and banks do not monitor such loans rigorously, thereby lowering bank profits. The findings here unmask an important difference in the impact of these disaggregated categories of securitised assets on bank profits.

Gleaning at the balance sheet variables, greater capitalisation, diversification, bank size and deposit growth increase profits while credit quality, liquidity risk, funding costs and OCA reduce profits, all in accordance with theoretical priors. Contrasting theoretical priors, real GDP growth has a negative impact on profits. This suggests during the upward phase of the business cycles bank managers may resort to a liberal credit policy without doing specific evaluations of projects under the notion that the positive health of the economy will be sustained. However, this results in increasing losses from such poorly monitored loans in the future, reducing banks ROA. Finally, changes in HPI and nominal prime loan rates significantly raise banks ROA. The same applies for inflation except in the case of HEL and auto loans securitisation.[4]

As an alternate measure of bank profitability, we also used return on equity (ROE). ROE indicates the return to shareholders on their equity and equals ROA times the total assets-to-equity ratio. Thus, the estimations using ROE exclude banks' capital-to-assets ratio. Both the shares of MBS and other consumer loans were positively significant in increasing bank profits. Results for the other controls mirrored findings very familiar to those using ROA.

4.2 Securitisation and leverage capital

Securitisation changes the risk profile of the asset side of banks' balance sheet. In realistic settings with taxes and bankruptcy costs, a bank will also change its optimal on-balance sheet capital structure, which in turn will affect its on-balance sheet leverage ratio (Leland, 2007; Jiangli and Pritsker, 2008). Securitisation may also affect the bank's leverage capital if the bank engages in regulatory capital arbitrage. This involves selling loans off its balance sheet to avoid regulatory capital charges, but retaining exposure to the credit risk by retaining an implicit agreement with the SPV that the bank will buy back its nonperforming loans.

From another perspective, when the bank transfers the asset pool to the SPV, then it has to decide how to use the amount of liquidity from the asset sale. It can keep cash on balance sheet, it can invest in less risky assets, or it can use liquidity to repay debt. In all these cases, the risk-weighted assets will decrease and so the capital ratio will increase. In case of risk retention, if the bank considers that the securitisation exposure may require a higher capital buffer, the bank would increase its capital.

Following the literature on the determinants of banks' capital structure (Estrella et al., 2000; Gropp and Heider, 2009), the impact of securitisation on banks' leverage capital is examined using the following estimation equation:

$$\text{Leverage Capital}_{jt} = c_{0t-1} + c_{jt-1}\,(SA_{jt-1}) + c_{kt-1}\,(Z_{jt-1}) + \mu_j + \lambda_t + \varepsilon_{jt} \tag{4}$$

where Z_{jt} denotes a vector of variables explaining leverage capital.

Zj = [size, ROA, loans-to-assets, provision for loan losses-to-total loans, real GDP growth, log of inflation, term premium].

Table 3 Fixed-effects results for bank profits

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
Variables	*Overall*	*MBS*	*ABS*	*HEL*	*Credit card*	*Auto*	*Other consumer*	*Other loans*	*C&I*
Capital-to-Assets$_{(t-1)}$	**0.046*****	**0.043*****	**0.046*****	**0.071*****	**0.086*****	**0.073*****	**0.043*****	**0.048*****	**0.045*****
	(57.12)	(55.69)	(5.05)	(39.88)	(2.75)	(3.13)	(5.55)	(57.22)	(4.65)
Credit Quality$_{(t-1)}$	**–0.002***	**–0.013*****	0.002	**–0.004***	–0.010	–0.001	–0.001	**–0.011*****	–0.002
	(–1.61)	(–4.18)	(0.54)	(–1.81)	(–1.29)	(–1.14)	(–0.83)	(–3.73)	(–0.89)
Diversification$_{(t-1)}$	**0.196*****	**0.18*****	0.195	**0.102*****	**2.689*****	**0.521*****	0.160	**0.156*****	0.170
	(–24.12)	(26.35)	(1.51)	(15.49)	(5.08)	(2.62)	(1.38)	(23.07)	(1.46)
Liquidity risk$_{(t-1)}$	**–0.001*****	**–0.348*****	**–0.001*****	**–0.377*****	–0.016	**–0.385****	**–0.001*****	0.000	**–0.001****
	(–3.31)	(–17.9)	(–2.27)	(–9.24)	(–0.54)	(–2.26)	(–2.86)	(–0.15)	(–2.28)
OCA$_{(t-1)}$	**–0.103*****	**–0.898*****	0.093	–0.167	0.581	–3.701	0.040	**–0.688*****	0.082
	(–2.98)	(–13.88)	(0.54)	(–0.72)	(0.8)	(–1.38)	(0.23)	(–10.77)	(0.4)
Funding costs$_{(t-1)}$	–0.001	0.000	0.000	–11.586	0.000	–0.470	**–0.142*****	**–0.826*****	**–0.169*****
	(–1.37)	(–0.8)	(–0.88)	(–13.25)	(–0.17)	(–0.05)	(–15.61)	(–10.53)	(–4.34)
Size$_{(t-1)}$	**0.285*****	**0.221*****	**0.289*****	0.019	**0.264*****	0.026	**0.243*****	**0.215*****	**0.249*****
	(45.83)	(41.09)	(8.54)	(1.02)	(2.67)	(0.33)	(10.54)	(38.7)	(9.39)
Δlog(Deposits)$_{(t-1)}$	**0.026*****	**0.06*****	0.023	**0.497*****	0.033	**0.443*****	**0.046*****	**0.092*****	0.052
	(2.19)	(5.74)	(0.47)	(15.03)	(0.26)	(4.99)	(1.8)	(8.52)	(1.26)
Securitisation share$_{(t-1)}$	**0.876*****	0.000	**1.107*****	0.049	0.034	0.422	**–0.05*****	**0.001*****	**0.521*****
	(31.65)	(1.02)	(2.02)	(0.1)	(0.88)	(1.01)	(–3.83)	(4.71)	(1.77)

Table 3 Fixed-effects results for bank profits (continued)

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
Variables	*Overall*	*MBS*	*ABS*	*HEL*	*Credit card*	*Auto*	*Other consumer*	*Other loans*	*C&I*
Real GDP growth$_{(t-1)}$	**–0.02*****	**–0.021*****	**–0.021*****	0.004	**–0.022*****	0.006	**–0.022*****	**–0.024*****	**–0.022*****
	(–4.95)	(–6.08)	(–6.35)	(0.71)	(–2.59)	(1)	(–7.38)	(–6.6)	(–7.26)
log(Inflation)$_{(t-1)}$	**0.013*****	**0.01*****	**0.013*****	**–0.026*****	0.007	**–0.028*****	**0.011*****	**0.013*****	**0.011*****
	(5.2)	(4.86)	(4.69)	(–5.54)	(1.15)	(–3.72)	(4.7)	(5.87)	(4.17)
log(r)$_{(t-1)}$	**5.627*****	**4.924*****	**5.614*****	**–40.366*****	**5.468*****	**–50.783*****	**5.33*****	**5.311*****	**5.651*****
	(40.77)	(41.66)	(21.15)	(–6.67)	(10.5)	(–3.01)	(24.2)	(43.84)	(22.92)
Δlog(HPI)$_{(t-1)}$	**6.495*****	**6.816*****	**6.497*****	**1.197*****	**6.581*****	0.889	**6.509*****	**6.51*****	**6.457*****
	(51.04)	(62.94)	(27.27)	(4.33)	(13.21)	(1.34)	(30.17)	(58.27)	(26.65)
Constant	**–1.943*****	**–1.112*****	**–1.979*****	**0.468*****	**–2.266*****	0.102	**–1.413*****	**–1.216*****	**–1.585*****
	(–29.79)	(–19.55)	(–5.57)	(1.87)	(–2.21)	(0.12)	(–6.11)	(–20.8)	(–5.99)
adj. R^2	0.0547	0.0668	0.0556	0.0567	0.096	0.0499	0.0677	0.0682	0.055
F-stat	1111	1360	138	244	39	19	170	1221	157
N	274,207	271,729	274,210	99,840	67,397	93,571	269,604	238,860	267,216

ROA is defined as net income after tax as a percent of average total assets; Capital-to-Assets is the ratio of total equity capital to total assets; Credit quality is the ratio of loan losses-to-total loans; Diversification is the ratio of non-interest income to total income; Liquidity risk is measured by the sum of cash and investment securities-to-total assets. OCA denotes banks overhead cost-to-assets and is the ratio of non-interest expenses-to-total assets; Δlog(Deposits) denotes growth rate of banks total deposits; Size is the logarithmic value of total assets; Securitisation share is the ratio of specific type of securitised assets –to-total assets or that specific loan type. Inflation rate is the percent change in personal consumption expenditure, log(r) is the logarithmic value of bank prime loan rate; Δlog(HPI) denotes growth rate in US housing price index. Terms in brackets denote z-stats based on robust standard errors clustered in banks. Terms in bold denote statistically significant coefficients.

*, **, *** indicates significance at the 10%, 5%, 1% level.

Bank leverage capital is measured as tier 1 (core) capital as a percent of average total assets minus ineligible intangibles. Term premium is defined as the interest rate spread between 10-year and 3-month US Treasury constant maturities.[5]

Banks facing higher cost of issuing equity should be less levered. Banks with higher profits can, therefore, be expected to face lower costs of issuing equity because they are better known to outsiders, have more financial slack or can obtain a better price (Gropp and Heider, 2009). Larger banks may hold smaller capital buffers if they are better known to the market. An increase in credit quality is expected to reduce leverage capital, while a greater share of loans should raise banks leverage capital.

Moving to the results in Table 4, aggregate securitisation activity significantly raises banks leverage capital illustrating another beneficial impact of securitisation. The same applies for MBS, ABS, credit card and other consumer loans. The findings are broadly consistent with that of Cebenoyan and Strahan (2004), Uzun and Webb (2007) for MBS and HEL, and the risk-weighted capital ratio of Scopelliti (2015). The results further suggest that the magnitude of the overall securitisation activity coefficient is primarily driven by the high coefficient of ABS. It also illustrates that the transfer of risk is not complete and banks retain risks from these loans and hence shore up their capital bases. On the other hand, HEL reduces banks leverage capital. As expected, higher bank size reduces leverage capital. Somewhat surprisingly, the coefficient of profits is positive. This implies when bank profits rise, banks try to preserve their franchise value and hence have higher incentives to remain well capitalised. We also find evidence that higher loans-to-assets increases banks leverage capital. Higher inflation rate, real GDP growth and term premium reduces it. The latter finding indicates when the economy is sound and bonds market risks are low, banks do not need to take a conservative position by shoring up their capital base.

4.3 Securitisation and bank diversification

The combination of regulatory reform, financial innovation, and technological progress has dramatically changed the business of banking in the USA. Over the last two decades, banks offer more products and services by engaging in a broad range of activities like securities and insurance underwriting, merchant banking etc. It is conceivable that securitisation helps reshape banks' business model by increasing the scope of diversification. In the past, the major source of banks' earnings was lending activities that were exclusively funded by customer deposits. But with the advent of securitisation, banks have the option of financing a loan with deposits or, via securitisation. This also makes supply of credit from banks less sensitive to banks' balance sheet and financial conditions (Loutskina and Strahan, 2009). So, the cheap source of funding from deposits could now be used in other lines of business. Hence, securitisation is expected to increase banks diversification.

The impact of securitisation on banks diversification is modelled as follows:

$$\text{Diversification}_{jt} = d_{0t-1} + d_{t-1}\,(SA_{jt-1}) + d_{kt-1}\,(Z_{jt-1}) + \mu_j + \lambda_t + \varepsilon_{jt} \tag{5}$$

where Zj = [size, ROA, loans-to-assets, real GDP growth].

Diversification is measured by the share of non-interest income to total income.

Table 4 Results for banks leverage capital

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
Variables	*Overall*	*MBS*	*ABS*	*HEL*	*Credit card*	*Auto*	*Other consumer*	*Other loans*	*C&I*
$Size_{(t-1)}$	**–1.766*****	**–1.464*****	**–1.738*****	**–2.931*****	**–0.858*****	**–2.761*****	**–1.331*****	**–1.227*****	**–1.424*****
	(–117.37)	(–9.04)	(–115.86)	(–101.07)	(–36.28)	(–95.62)	(–96.67)	(–9.83)	(–107.05)
$ROA_{(t-1)}$	**0.24*****	**0.244*****	**0.237*****	**0.218*****	**0.362*****	**0.224*****	**0.201*****	**0.266*****	**0.211*****
	(48.16)	(4.77)	(47.59)	(39.78)	(52.3)	(39.55)	(37.18)	(5.24)	(45.01)
Insolvency $risk_{(t-1)}$	**–0.011*****	0.002	**–0.011*****	0.001	0.002	0.003	0.000	0.003	0.000
	(–3.42)	(0.52)	(–3.48)	(0.36)	(0.33)	(0.76)	(0.06)	(0.51)	(0)
Loans-to-$Assets_{(t-1)}$	**0.021*****	**0.024*****	**0.02***	**0.01***	**–0.857*****	**0.01****	**0.022*****	**0.028****	**0.023*****
	(1.76)	(1.6)	(1.74)	(1.91)	(–5.53)	(2.09)	(2.12)	(2.16)	(2.31)
Securitisation $share_{(t-1)}$	**2.47*****	**0.001*****	**3.102*****	**–1.562*****	**0.322*****	0.415	**0.176*****	–0.001	–0.110
	(35.06)	(4.52)	(38.89)	(–1.92)	(28.51)	(0.79)	(2.01)	(–1.35)	(–0.41)
Real GDP $growth_{(t-1)}$	**–0.021*****	**–0.02*****	**–0.021*****	0.000	**0.027*****	0.002	–0.013	–0.006	**–0.014*****
	(–2.19)	(–2.53)	(–2.16)	(–0.01)	(1.76)	(0.32)	(–1.43)	(–0.83)	(–1.62)
$log(Inflation)_{(t-1)}$	**–0.01***	**–0.019****	**–0.011***	**0.016*****	0.010	**0.014****	**–0.019*****	**–0.029*****	**–0.014*****
	(–1.63)	(–2.08)	(–1.72)	(2.35)	(0.98)	(2.09)	(–3.31)	(–3.02)	(–2.5)
Term $premium_{(t-1)}$	**–0.099*****	**–0.099*****	**–0.099*****	0.006	**–0.089*****	–0.004	**–0.101*****	**–0.092*****	**–0.101*****
	(–22.07)	(–14.05)	(–22.07)	(0.86)	(–12.66)	(–0.54)	(–25.14)	(–13.07)	(–25.56)
Constant	**25.807*****	**22.87*****	**25.525*****	**32.087*****	**15.492*****	**30.308*****	**21.829*****	**20.260*****	**22.606*****
	(175.41)	(14.61)	(174.03)	(98.32)	(63.77)	(94.09)	(162.44)	(16.23)	(174.19)
adj. R^2	0.0702	0.0798	0.0706	0.157	0.0813	0.1554	0.0539	0.0539	0.0761
F-stat	2079.98	108.29	2096.37	1954.22	658.39	93576	1264.4	88.74	1565.96
N	279,141	276,618	279,145	99,845	68,940	1807	274,470	243,000	272,036

Leverage capital is the ratio of tier-1(core) capital-to-average total assets; Size is the logarithmic value of total assets; Insolvency risk is the ratio of provision for loan and lease losses-to-total loans; ROA is defined as net income after tax as a percent of average total assets; Loans-to-assets is the share of total loans-to-total assets; Securitisation share is the ratio of specific type of securitised assets –to-total assets or that specific loan type. Term premium is the interest rate spread between 10-year and 3-month US Treasury constant maturities; Inflation rate is the percent change in personal consumption expenditure. Terms in brackets denote z-stats based on robust standard errors clustered in banks. Terms in bold denote statistically significant coefficients.

*, **, *** indicates significance at the 10%, 5%, 1% level.

Table 5 Results for banks diversification

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
Variables	*Overall*	*MBS*	*ABS*	*HEL*	*Credit card*	*Auto*	*Other consumer*	*Other loans*	*C&I*
Capital-to-Assets$_{(t-1)}$	–0.002	–0.027	**–0.003****	–0.037	0.011	0.048	–0.003	**–0.003*****	**–0.003*****
	(–0.67)	(–0.52)	(–2.25)	(–0.23)	(0.68)	(0.33)	(–1.56)	(–3.23)	(–2.79)
ROA$_{(t-1)}$	**0.008*****	**0.014*****	**0.008*****	**0.025*****	**0.014*****	**0.03*****	**0.013*****	**0.014*****	**0.011*****
	(5.53)	(6.5)	(5.52)	(3.91)	(5.08)	(4.81)	(5.57)	(5.79)	(5.29)
Size$_{(t-1)}$	**–0.009*****	**–0.008*****	**–0.009*****	**–0.029*****	**–0.017*****	–0.015	**–0.008****	**–0.01****	**–0.008****
	(–2.72)	(–2.16)	(–2.77)	(–1.63)	(–3.32)	(–1.35)	(–2.27)	(–2.63)	(–2.2)
Loans-to-Assets$_{(t-1)}$	0.000	**–0.001*****	0.000	**–0.001*****	**–0.016***	**–0.003*****	**–0.004*****	**–0.004*****	**–0.004*****
	(–0.84)	(–3.02)	(–0.84)	(–3.81)	(–1.76)	(–3.92)	(–2.99)	(–3.46)	(–3.15)
Securitisation share$_{(t-1)}$	**0.018***	**–0.025***	0.015	**2.118*****	**0.013***	0.015	–0.006	–0.022	0.024
	(10.95)	(–1.71)	(0.86)	(149.03)	(1.65)	(1.02)	(–0.42)	(–0.84)	(0.6)
Real GDP growth$_{(t-1)}$	0.000	–0.003	0.000	0.002	**–0.001****	0.000	–0.013	–0.030	–0.005
	(0.59)	(–0.05)	(0.58)	(0.82)	(–2.35)	(–0.42)	(–0.2)	(–0.41)	(–0.07)
Constant	**0.234*****	0.207	**0.235*****	**0.399*****	**0.34*****	**0.27*****	**0.214*****	**0.231*****	**0.212*****
	(7.7)	(5.84)	(7.76)	(2.27)	(6.35)	(2.24)	(6.45)	(7.03)	(6.94)
adj. R^2	0.009	0.0252	0.0082	0.0207	0.0471	0.017	0.011	0.0024	0.026
F-stat	6.42	9.98	6.63	155890.79	4.72	8.41	9.88	10.69	7.97
N	305876	302090	305880	105243	75211	98611	299841	265516	297068

Diversification is defined as the ratio of non-interest income to total income; Capital-to-Assets is the ratio of total equity capital to total assets; ROA is defined as net income after tax as a percent of average total assets; Size is the logarithmic value of total assets; Loans-to-assets is the share of total loans-to-total assets; Securitisation share is the ratio of specific type of securitised assets –to-total assets or that specific loan type. Terms in brackets denote z-stats based on robust standard errors clustered in banks. Terms in bold denote statistically significant coefficients.

*, **, *** indicates significance at the 10%, 5%, 1% level.

Table 6 Results for net securitisation income

	[1]	*[2]*	*[3]*	*[4]*	*[5]*	*[6]*	*[7]*	*[8]*	*[9]*
Variables	*Overall*	*MBS*	*ABS*	*HEL*	*Credit card*	*Auto*	*Other consumer*	*Other loans*	*C&I*
Capital-to-Assets$_{(t-1)}$	**0.006*****	0.000	**0.006*****	0.000	**0.02*****	0.000	**0.006*****	**0.006*****	**0.006*****
	(17.14)	(–0.57)	(63.93)	(1.4)	(4.32)	(1.28)	(27.1)	(92.13)	(71.02)
ROA$_{(t-1)}$	0.025	0.002	0.025	–0.009	0.001	–0.001	0.009	0.002	0.007
	(1.34)	(1.03)	(1.34)	(–0.74)	(1.38)	(–0.69)	(0.42)	(0.8)	(0.47)
Size$_{(t-1)}$	–0.039	–0.011	–0.035	0.002	**–0.028***	0.021	–0.044	–0.028	0.008
	(–1.41)	(–1.47)	(–1.26)	(0.15)	(–1.68)	(0.17)	(–0.58)	(–0.28)	(0.01)
Loans-to-Assets$_{(t-1)}$	–0.078	0.025	–0.087	–0.007	–0.022	–0.001	0.009	–0.007	–0.066
	(–1.05)	(0.78)	(–1.13)	(–1.54)	(–1.2)	(–1.47)	(0.23)	(–0.21)	(–0.2)
Securitisation share$_{(t-1)}$	**0.007****	0.000	0.008	0.001	**0.006***	0.032	–0.051	0.052	**0.016****
	(2.04)	(–0.55)	(1.01)	(0.85)	(1.87)	(1.5)	(–0.76)	(0.65)	(2.13)
Real GDP growth$_{(t-1)}$	–0.002	–0.029	–0.003	**0.03*****	–0.014	**0.026***	–0.009	–0.057	–0.054
	(–1.32)	(–0.91)	(–1.4)	(2.05)	(–1.53)	(1.7)	(–0.24)	(–1.33)	(–1.32)
Constant	0.003	0.001	0.003	–0.006	0.026	–0.006	0.009	0.002	–0.039
	(1.3)	(1.52)	(1.14)	(–0.49)	(1.7)	(–0.48)	(0.12)	(0.02)	(–0.5)
adj. R^2	0.119	0.004	0.161	0.007	0.372	0.001	0.231	0.411	0.463
F-stat	184.97	2.23	1936.83	32.34	3.49	6.549	107.5	8395.46	2,440
N	305,874	302,087	305,878	105,248	75,211	98,616	299,836	265,521	297,068

Net securitisation income reports net gains or (losses) on assets sold in securitisation transactions. These include fees, other than servicing fees, earned from the bank's securitisation transactions and unrealised losses (and recoveries of unrealised losses) on loans and leases held for sale in securitisation transactions. It is measured as a share of total assets. Capital-to-Assets is the ratio of total equity capital to total assets; ROA is defined as net income after tax as a percent of average total assets; Size is the logarithmic value of total assets; Loans-to-assets is the share of total loans-to-total assets; Securitisation share is the ratio of specific type of securitised assets –to-total assets or that specific loan type. Terms in brackets denote z-stats based on robust standard errors clustered in banks. Terms in bold denote statistically significant coefficients.

*, **, *** indicates significance at the 10%, 5%, 1% level.

As hypothesised above, results in Table 5 confirm the positive impact of securitisation on bank diversification, unlike that of Case et al. (2013). A unit rise in aggregate securitisation activity increases diversification by 0.018 units. Within disaggregate categories; securitisation of HEL, credit card receivables is also positively significant. Somewhat surprisingly, MBS significantly reduce diversification. Real estate loans are most often the dominant category of banks asset portfolio. As such interest income earned from mortgage lending and non-interest income based income are substitutes of one another. The negative coefficient of MBS indicates that securitisation of mortgages allows banks to transfer credit risks off their balance sheets and hence incentivises them to indulge in more real estate lending and move away from non-interest income based activities.

Expectedly, higher bank profits significantly raise diversification. An increase in the share of loans in banks overall asset portfolio increases lending specialisation, and hence significantly lowers diversification. Banks capitalisation and size are largely insignificant. Finally, increase in real GDP growth significantly reduces bank diversification, suggesting during economic downturns non-interest based income drive banks operating income relative to interest-based income.

4.3.1 Impact on net securitisation income

Since March 2001, it has become mandatory on the part of banks to report various categories of non-interest income. Once such related disaggregated category of non-interest income is net securitisation income that reports net gains or (losses) on assets sold in securitisation transactions. It includes fees, other than servicing fees, earned from the banks securitisation transactions and unrealised losses (and recoveries of unrealised losses) on loans and leases held for sale in securitisation transactions.

Table 6 presents the fixed effects results for the impact of securitisation activities on net securitisation income (scaled by total assets), again using the estimation framework of equation (5). The extent of overall securitisation activity significantly raises banks net securitisation income, with a one unit rise in securitisation activity increasing net income by 0.007 units. Dissecting across specific securitisation categories, both credit card and C&I loans securitisation are positively significant in affecting net securitisation income while the other categories are insignificant. Among the other controls, higher equity capital increase net securitisation income. The same applies for real GDP growth in the case of HEL and auto loans.

5 Securitisation and bank risks

5.1 Securitisation and credit risks

Securitisation was developed as a credit risk transfer technique, aimed at removing the credit risk of an asset pool from the originator's balance sheet. See discussions in Chen et al. (2017), Kobayashi and Osano (2012) and van Oordt (2014). If the credit risks exposure arising from the securitised pool makes banks more risk-averse and motivates them to shift their portfolios towards assets of lower credit risk, banks' outstanding securitisation balances should reduce credit risk taking by banks (Casu et al., 2011, 2013). On the contrary, by allowing banks to convert illiquid assets into liquid funds,

securitisation increases the expansion of credit incentivising banks to hold riskier assets. Since securitisation provides banks with an additional source of loan financing and liquidity, it motivates them to shift their portfolios towards higher risk/return assets (Cebenoyan and Strahan, 2004; Purnanandam, 2011). Typically banks issuing securitised assets retain first-loss contractual interests and/or provide implicit recourse in securitisations. These arrangements mean that the risks inherent in the securitised assets have not been transferred to investors and are, in effect, still held by the issuing bank, but off-balance-sheet. Studies on the risk implications of securitisation generally find that banks transfer low credit risk assets to the trust and are thus left with lower quality assets on the balance sheet (Uzun and Webb, 2007). So, if the assets remaining on-balance sheet are of lower credit quality than assets sold to the trust, securitisation increases risk.[6] Moreover, the transfer of credit risk is not always complete and risk retention for banks could well vary by type of securitisation.

Credit risk is modelled using the following estimation model:

$$\Delta\text{Credit Risk}_{jt} = a_{0t-1} + a_{jt-1}\,(SA_{jt-1}) + a_{kt-1}\,(X_{jt-1}) + \mu_j + \lambda_t + \varepsilon_{jt} \tag{6}$$

Following Casu et al. (2011), credit risk of bank j in quarter t is measured by its share of risk weighted assets to total assets in that quarter. SA_j denotes the extent of securitisation; X_j is a vector of bank-specific factors and macroeconomic controls.

Xj = [size, total equity capital-to-assets, loans-to-assets, ROA, net charge-off rate, real GDP growth].

Large size banks often resort to excessive risk taking on the notion of 'too big to fail'. So, bank size is expected to increase credit risk. Managers in banks with low capital bases have a moral hazard incentive to engage in risky lending practices along with poor credit scoring and lax monitoring of borrowers. So the effect of total equity capital-to-assets on credit risk is expected to be negative. A greater share of loans in banks overall asset portfolio signifies more lending specialisation. A rise in this ratio is indicative of developing a comparative advantage in lending where banks are able to better monitor such loans. Thus, its coefficient is expected to be negative. We expect a negative impact of bank profitability on risk as one could argue that poor-performing banks (i.e., ones with low ROA) pursue risky activities to re-establish profitability. To control for 'cherry-picking' when banks choose to securitise the low-performing pool of their assets and the related issues of lax monitoring of such loans, their poor performance and its consequent impact on bank's risks, we include net loan charge-off rates. A negative relationship could also be expected between the charge-off ratio and risk taking. Poor loan performance in a preceding quarter (i.e., as evidenced by a high charge-off ratio) should discourage the bank manager from taking on extra risk in the following quarter and motivate investing in low risk/secure return assets (Casu et al., 2011). A booming economy encourages banks to undertake new and different ventures and hence raises the associated risks. Thus, real GDP growth should positively affect credit risks.

Results in Table 7 show overall securitisation activity significantly reduces credit risks, similar to that of Casu et al. (2011, 2013) and Cebenoyan and Strahan (2004). ABS significantly reduces banks credit risks while the effect of MBS is statistically insignificant. Within ABS, both securitised HEL and C&I loans significantly lower credit risks. The lack of significance of MBS but the significance of ABS and some of its underlying categories are consistent with the views espoused by Chen et al. (2008),

Higgins and Mason (2004) that banks are likely to retain less risk, through both contractual and non-contractual arrangements, in MBS due to relatively low and easy externally verifiable credit risk of mortgage loans. Mortgages are also closed-ended loans as opposed to revolving loans such as HEL, which makes securitisations of the latter more implicit recourse requiring. Non-mortgage securitisation, however, allows banks to remove riskier asset out of their balance sheet and share potential risk with a large number of investors, decreasing the expected losses and hence reducing credit risks (Minton et al., 2009).

The other categories of securitisation activities do not significantly affect credit risk. Most of the bank-specific controls have signs in accordance with their theoretical priors. Greater bank size significantly increases credit risk for all categories excepting credit card receivables. Greater bank equity capital reduces credit risks in the case of HEL, credit cards and auto loans. The same applies for loans-to-assets for both overall securitisation, ABS and its underlying categories of credit card, other consumer loans, other loans and C&I loans. Interestingly, greater bank profits significantly increase credit risks in the case of MBS. This implies when banks earn higher profits it incentivises their managers to undertake more risks, say, by resorting to a liberal credit policy. Banks net charge-off rates are largely insignificant (with the exception of credit card) while US real GDP growth significantly increases bank risks.[7]

5.2 Impact on insolvency risk

The process of securitisation can be viewed as a credit-derivative transaction that transforms the risk profile of the asset side of a bank's balance sheet (Jiangli and Pritsker, 2008). Holding the liability side of the balance sheet unchanged, and focusing on the asset side alone, securitisation can lower insolvency risk since it can serve as insurance against bank insolvency during severe adverse states of the economy. As espoused by Jiangli and Pritsker (2008), this is sensible since in the standard securitisation process, the upper tranches are usually sold (through the SPV) to outside investors and the issuing bank usually holds the most subordinated or the equity tranche. The credit loss to the equity tranche is truncated by the level of subordination while losses in the most severe states, the tail loss, are absorbed by outside investors that own the upper tranches. On the other hand, banks may also have incentives to securitise better-quality loans in the portfolio to pursue higher reputations or ratings, thus increasing bank risk on the balance sheet.

Banks insolvency risk is measured using z-score values. This is a balance-sheet based backward bending measure of risk that is based on the amount of buffer the bank has, to guard against shocks to earnings. Larger values of z-score imply lower probability of default and, hence, greater bank soundness.

$$\text{Z-score}_{jt} = [(\text{ROA})_{jt} + (\text{Total Equity Capital/Assets})_{jt}/\sigma(\text{ROA})_{jt}] \quad (7)$$

Since this measure is highly skewed, we follow the recent literature (see, e.g., Laeven and Levine, 2009) and use its log transformation in our analysis. Results based on estimation framework of equation (6) are shown in Table 8.

Table 7 Credit risk results

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
Variables	*Overall*	*MBS*	*ABS*	*HEL*	*Credit card*	*Auto*	*Other consumer*	*Other loans*	*C&I*
Securitisation share$_{(t-1)}$	**–0.011***	0.000	**–0.013***	**–0.029*****	0.000	–0.005	0.001	0.000	–0.017
	(–1.82)	(–0.6)	(–1.87)	(–19.63)	(–0.6)	(–0.79)	(1.02)	(–1.4)	(–1.57)
Size$_{(t-1)}$	**0.097****	**0.084***	**0.093***	**0.019*****	0.015	**0.019*****	**0.001****	**0.092***	**0.099****
	(2.06)	(1.81)	(1.98)	(11.27)	(1.35)	(11.12)	(2.12)	(1.74)	(2.1)
Capital-to-Assets$_{(t-1)}$	–0.004	–0.002	–0.004	**–0.012*****	**–0.08*****	**–0.014*****	–0.041	–0.018	0.003
	(–0.41)	(–0.2)	(–0.37)	(–4.99)	(–2.52)	(–4.96)	(–0.32)	(–1.49)	(0.03)
Loans-to-Assets$_{(t-1)}$	**0.006***	0.005	**0.006***	0.004	**0.053***	0.005	**0.06***	**0.008***	**0.006***
	(1.64)	(1.47)	(1.62)	(1.06)	(1.68)	(1.28)	(1.82)	(2.62)	(1.77)
ROA$_{(t-1)}$	0.045	**0.06*****	0.046	0.006	0.006	–0.002	0.031	**0.058****	**0.048*****
	(1.39)	(3.39)	(1.39)	(0.18)	(0.63)	(–0.06)	(1.12)	(2.34)	(3.22)
Charge-off rate$_{(t-1)}$	0.033	0.005	0.035	0.004	**0.064*****	0.001	–0.002	0.005	–0.065
	(0.11)	(1.39)	(0.11)	(1.48)	(2.53)	(0.01)	(–1.09)	(1.45)	(–0.26)
Real GDP growth$_{(t-1)}$	**0.033*****	**0.033*****	**0.033**	**0.061*****	**0.033*****	**0.064*****	**0.033*****	**0.033*****	**0.034*****
	(29.03)	(29.14)	(29.03)	(23.52)	(14.76)	(23.63)	(29.38)	(27.66)	(29.55)
Constant	**–0.012*****	**–0.011*****	**–0.011*****	**–0.259*****	–0.013	**–0.263*****	**–0.012*****	**–0.01*****	**–0.012*****
	(–2.43)	(–2.39)	(–2.38)	(–14.3)	(–1.01)	(–13.87)	(–2.48)	(–2.02)	(–2.65)
adj. R^2	0.032	0.0112	0.0101	0.0167	0.004	0.0179	0.0036	0.0054	0.0032
F-stat	110.73	115.08	110.69	562.81	30.92	148.28	113.5	107.57	118.71
N	299,406	296,698	299,406	99,853	74,117	93,596	294,482	260,851	291,815

Credit risk is the ratio of risk weighted assets to total assets; Securitisation share is the ratio of specific type of securitised assets –to-total assets or that specific loan type. Size is the logarithmic value of total assets; Capital-to-Assets is the ratio of total equity capital to total assets; Loans-to-assets is the share of total loans-to-total assets; ROA is defined as net income after tax as a percent of average total assets. Charge-off rate is defined as total loans and leases charged-off (removed from balance sheet because of uncollectibility), less amounts recovered on loans and leases previously charged-off as a share of Total loans and leases. Terms in brackets denote z-stats based on robust standard errors clustered in banks. Terms in bold denote statistically significant coefficients.

*, **, *** indicates significance at the 10%, 5%, 1% level.

Table 8 Insolvency risk results

	[1]	*[2]*	*[3]*	*[4]*	*[5]*	*[6]*	*[7]*	*[8]*	*[9]*
Variables	*Overall*	*MBS*	*ABS*	*HEL*	*Credit card*	*Auto*	*Other consumer*	*Other loans*	*C&I*
Securitisation share$_{(t-1)}$	–0.082	0.050	**–0.114***	**–0.766*****	–0.018	0.025	–0.002	0.002	–0.065
	(–1.41)	(0.8)	(–1.72)	(–55.95)	(–1.34)	(0.7)	(–0.81)	(1.28)	(–1.35)
Size$_{(t-1)}$	**0.015*****	**0.013*****	**0.014*****	**–0.051*****	**0.016*****	**–0.05*****	**0.011*****	**0.013*****	**0.013*****
	(3.97)	(3.74)	(3.82)	(–4.33)	(2.36)	(–4.07)	(4.22)	(4.4)	(4.09)
Capital-to-Assets$_{(t-1)}$	**5.009*****	**5.675*****	**5.014*****	**5.376*****	**5.345*****	**5.644*****	**5.694*****	**5.776*****	**5.515*****
	(22.7)	(25.17)	(22.7)	(17.99)	(12.73)	(15.95)	(28.05)	(27.55)	(24.89)
Loans-to-Assets$_{(t-1)}$	**–0.077*****	**–0.012*****	**–0.077*****	**–0.084*****	–0.008	**–0.09*****	**–0.001*****	**–0.011*****	**–0.01*****
	(–2.21)	(–3)	(–2.22)	(–3.2)	(–0.63)	(–3.47)	(–3.73)	(–3.29)	(–2.98)
ROA$_{(t-1)}$	**0.062*****	**0.08*****	**0.062*****	**0.078*****	**0.038*****	**0.082*****	**0.08*****	**0.079*****	**0.07*****
	(10.39)	(21.18)	(10.43)	(14.74)	(4.28)	(15.56)	(20.51)	(20.05)	(11.56)
Charge-off rate $_{(t-1)}$	0.001	0.013	0.001	0.001	0.001	–0.037	–0.009	0.012	–0.071
	(0.05)	(1.04)	(0.05)	(0.19)	(0.48)	(–1.24)	(–1.39)	0.86)	–0.62)
Real GDP growth$_{(t-1)}$	**0.004*****	**0.003*****	**0.004*****	**–0.003*****	**0.007*****	**–0.003*****	**0.003*****	**0.003*****	**0.004*****
	(7.26)	(6.44)	(7.25)	(–3.35)	(5.07)	(–3.2)	(6.1)	(6.06)	(6.55)
Constant	**2.471*****	**2.389*****	**2.476*****	**2.923*****	**2.48*****	**2.913*****	**2.409*****	**2.376*****	**2.421*****
	(59.08)	(72.55)	(59.22)	(23.72)	(35.37)	(22.31)	(70.37)	(70.94)	(64.14)
adj. R^2	0.463	0.505	0.463	0.342	0.429	0.352	0.501	0.501	0.486
F-stat	111.53	214.4	111.35	99,756	51.42	149.63	172.52	178.92	131.84
N	299,142	296,439	299,142	183,707	74,067	93,517	294,236	260,625	291,552

Insolvency risk is measured by the logarithmic value of banks z-score defined as $[(ROA)_{jt} + (Total\ Equity\ Capital/Assets)_{jt}/\sigma(ROA)_{jt}]$ where $\sigma(ROA)$ denotes standard of ROA. Securitisation share is the ratio of specific type of securitised assets –to-total assets or that specific loan type. Size is the logarithmic value of total assets; Capital-to-Assets is the ratio of total equity capital to total assets; Loans-to-assets is the share of total loans-to-total assets; ROA is defined as net income after tax as a percent of average total assets. Charge-off rate is defined as total loans and leases charged-off (removed from balance sheet because of uncollectibility), less amounts recovered on loans and leases previously charged-off as a share of Total loans and leases. Terms in brackets denote z-stats based on robust standard errors clustered in banks. Terms in bold denote statistically significant coefficients.

*, **, *** indicates significance at the 10%, 5%, 1% level.

Table 9 Results for the pre- and post-crisis period

	Overall	*MBS*	*ABS*	*HEL*	*Credit card*	*Auto*	*Other consumer*	*Other loans*	*C&I*
Pre-crisis									
Profits	**0.731*****	0.000	0.882		–0.036		0.269	0.001	–0.245
	(12.91)	(0.27)	(1.5)		(–1.25)		(1.49)	(0.47)	(–1.24)
Leverage Capital	**0.938*****	**0.051*****	**0.861*****		–0.006		–0.169	0.000	–0.147
	(5.77)	(11.06)	(4.98)		(0.52)		(–0.12)	(0.22)	(–0.31)
Diversification	**0.005*****	**–0.006*****	**0.006*****		**0.002***		0.005	**–0.012*****	**0.046***
	(10.03)	(–32.51)	(10.52)		(1.62)		(0.61)	(–2.55)	(1.74)
Net securitisation income	0.035	–0.002	0.004		0.005		–0.008	–0.001	0.003
	(0.55)	(–0.77)	(0.55)		(1.04)		(–0.28)	(–1.02)	(0.18)
Credit risks	0.004	**–0.017*****	0.005		–0.001		**0.016***	**0.003***	–0.034
	(0.37)	(–29.05)	(0.37)		(–0.38)		(3.5)	(3.79)	(–1.32)
Insolvency risks	–0.027	**0.012*****	–0.032		0.090		0.037	0.018	–0.073
	(–1.44)	(32.23)	(–1.7)		(0.82)		(1.19)	(1.2)	(–1.06)

Table 9 Results for the pre- and post-crisis period (continued)

	Overall	*MBS*	*ABS*	*HEL*	*Credit card*	*Auto*	*Other consumer*	*Other loans*	*C&I*
Post-crisis									
Profits	**1.199*****	0.000	**1.814***	0.049	0.208	0.422	**0.025***	**0.001*****	0.652
	(26.95)	(0.34)	(1.96)	(0.1)	(1.28)	(1.01)	(1.74)	(5)	(1.4)
Leverage Capital	**2.991*****	**0.015*****	**4.393*****	**–1.562***	**0.895*****	0.415	0.071	–0.065	**–0.491***
	(34.38)	(3.75)	(40.93)	(–1.92)	(31.91)	(0.79)	(1.01)	(–1.51)	(–1.86)
Diversification	**0.127*****	0.001	**0.153*****	**2.118*****	0.018	0.015	–0.001	–0.002	–0.058
	(4.81)	(0.07)	(3.57)	(149.03)	(0.33)	(1.02)	(–0.29)	(–0.79)	(–0.01)
Net securitisation income	**0.038*****	0.006	**0.057*****	0.001	0.002	0.032	–0.002	0.000	0.002
	(2.81)	(0.35)	(5.9)	(0.85)	(0.87)	(1.5)	(–0.89)	(–0.4)	(0.8)
Credit risks	**–0.015*****	0.000	**–0.02*****	**–0.029*****	0.000	–0.005	–0.001	0.000	–0.014
	(–2.6)	(–0.58)	(–3.31)	(–19.63)	(–0.09)	(–0.79)	(–0.97)	(–1.4)	(–1.25)
Insolvency risks	–0.143	0.036	**–0.228*****	**–0.766*****	**–0.001***	0.025	–0.001	0.000	–0.015
	(–1.53)	(0.82)	(–1.78)	(–55.95)	(–1.62)	(0.7)	(–0.12)	(1.25)	(–0.48)

Terms in brackets denote z-stats based on robust standard errors clustered in banks. Terms in bold denote statistically significant coefficients.

*, **, *** indicates significance at the 10%, 5%, 1% level. For securitised HEL and auto loans there were insufficient observations during the 2001–2006 period.

Aggregate securitisation and MBS are insignificant in affecting bank z-score. ABS and its constituent category of HEL significantly reduce z-score increasing the probability of insolvency risk. The results contrast those of Chen et al. (2017), but are consistent with the notion that securitisation reduces banks temporary risks but have a long-term risk increase effect (see, again Chen et al., 2017). Both capital-to-assets and ROA are also positively significant, reducing banks insolvency risks. Same applies for higher real GDP growth.[8]

5.3 Results for the pre- and post-crisis period

The extant literature on securitisation has mainly focused on the period leading to the crisis. The post-crisis period has been rarely studied. We next identify any discernable difference between the effect of securitisation on bank performance during the pre- (2001–2006) and post-crisis (2007–2016) periods. This allows us to explore the extent to which the impact of securitisation on banks profitability and risks might change with the onset of the financial crisis from before it. For brevity purposes, results are restricted to the coefficients of the specific securitisation variables only (Table 9).

Before the crisis, overall securitisation increases banks' profits, leverage capital and diversification. It does not, however, have any significant impact on credit and insolvency risks. MBS, the largest component of securitised assets, increases banks leverage capital but reduce diversification, similar to the full-sample. Pointedly, MBS significantly reduces both credit and insolvency risks in the pre-crisis period.

The lower panel of Table 9 presents the results for the period during the financial crisis and its aftermath. Much like the results for the full sample and pre-crisis periods, the positive impact of securitisation on both bank profits and leverage capital are seen in the post-crisis period also. Aggregate securitisation activity, ABS, other consumer loans and other loans increase bank profits, again explaining why banks engage in securitisation. Aggregate securitisation as well as that of MBS, ABS and credit card receivables increase banks leverage capital. Likewise, aggregate securitisation, ABS and HEL-securitisation increases banks diversification in the post-crisis period. Similarly, net securitisation income is significantly increased by aggregate securitisation activity and ABS. The results for the two measures of risks are more intricate. On the one hand, credit risk is significantly reduced by MBS before the crisis and aggregate securitisation, ABS and HEL after the crisis. MBS also lower banks insolvency risks in the pre-crisis era. However, in the post-crisis period we do not find any significant impact of either aggregate securitisation or its largest constituent, MBS, to reduce banks default risk. In fact, default risk is increased by ABS, HEL and credit card receivables, an issue that would be concerning for banks engaged more in these categories of securitisation. This finding is consistent with the intuition that in the long-run securitisation can lead to a reduction in borrowing standards as banks would have greater incentives to undertake excessive risk.

6 Conclusion

Using bank level data on all 5491 commercial banks in the USA that were functional between 2001Q2–2016Q1, the present study provides a detailed examination of the role of securitisation in affecting different facets of banking in the USA. Summarising the results, securitisation increases banks profitability that is driven by ABS. Such a finding also applies in the period after the financial crisis. Exploring the channels through which securitisation affects bank profitability is a clear area of further research. Secondly, we find securitisation to augment banks leverage capital. This is especially relevant when considered in the context of the recent push by the US Federal Reserve to impose higher capital buffers on banks. The positive impact of securitisation on leverage capital can be used as an additional prudential tool to complement minimum capital adequacy requirements of banks and provide regulatory capital relief. Thirdly, as further value-additions to the literature, the beneficial effects of securitisation are seen not only on banks diversification activities but also on net securitisation income.

Finally, we find securitisation to reduce banks' credit risks that are consistent with the earlier studies predominantly using pre-crisis period data (Casu et al., 2010; 2013; Jiangli and Pritsker, 2008). This finding should provide comfort to US banking regulatory authorities on any apprehensions about the adverse effects of securitisation in enhancing credit risks. However, we find evidence that the beneficial impact of securitisation in reducing the chances of bank defaults to wane out in the post-crisis period.

In closing, our results illustrate the benefits of securitisation activities on bank performance. This also supports a clear need to improve regulation and supervision of sector-specific securitisation activities to ensure their costs do not exceed their benefits.

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Notes

[1]Creating this separate SPV isolates the cash flow generating assets and/or collateral so that securities issued by the SPV are not a general claim against the issuer, just against those assets.

[2]These include the outstanding principal balance of all other assets sold and securitised other than the earlier six categories.

[3]Data on real GDP growth are from the US Bureau of Economic Analysis. Housing prices are taken from US Federal Home Finance Agency, while inflation and interest rates are from the US Federal Reserve Board.

[4]As an additional explanatory variable we included banks loans-to-assets as bank profitability could be affected by the size of the loan portfolio (see for instance, Iannotta *et al.*, 2007; Molyneux and Thornton, 1992). Results remained unchanged.

[5]All variables were tested for panel unit roots. Variables that exhibited unit roots in their levels form were first-differenced to induce stationarity.

[6]Murray (2001) also suggests that securitisation can increase the institution's risk profile if an institution in effect removes only its most creditworthy assets from its balance sheet through securitisation.

[7]For purpose of robustness evaluations, we also used changes in non-performing loans (NPLs) as an alternate measure of credit risk. NPLs are measured as the sum of total loans and leases past due 90 days or more and non-accrual loans, divided by total (gross) loans. Aggregate securitisation as well as MBS, ABS, home equity loans and credit cards significantly reduced credit risks. For the other control variables, net charge-off rates and real GDP growth were negatively significant. Moreover, we employed the ratio of provision for loan losses-to-total loans and leases as a third measure of credit risk. Both aggregate securitisation and ABS were negatively significant. Results are available on request.

[8]For robustness checks, we also used the share of the sum of loan charge-offs and loans past 90 days or more to total loans and leases as an alternate measure of insolvency risks, similar to Jinagli and Pritsker (2008). Increase in overall securitisation activity as well as both MBS and ABS significantly reduced banks insolvency risks. The same applies for securitisation of credit card loans. Again results are available on request.