Credit Risk Management through Securitization: Effect on Loan Portfolio Choice

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The usage of securitization as a credit risk management tool, involves the departure of loans from the bank's balance sheet. As such, the employment of securitization as a means for risk offloading may have an effect on the composition and the size of the securitizing bank's loan portfolio. In this paper, we examine the dynamics of such effect. Using data on 129 FDIC-member banks, we have found that as banks use securitization to manage their credit risk exposures, they end up with more risky consumer loans and larger portfolios. These outcomes, in turn, lead to the banks having riskier, higher yielding and more diversified loan portfolios.

JEL Codes: G21, G32, G01

1. Introduction

Securitization plays a credit risk management role through the transfer of the pool of loans from the asset-originating bank to the Special Purpose Entity (SPE). To illustrate, as the loans are moved to the SPE during securitization, the loans leave the asset-originating bank's balance sheet, which results to the securitizing bank having offloaded the risk of the securitized loans. In short, securitization peforms its credit risk management function by providing a vent for risk.

A number of studies have shown that banks may have attempted to take advantage of the above property of securitization. Minton, Sanders & Strahan (2004), Pais (2005), Bannier & Hänsel (2007) and Affinito & Tagliaferri (2010) have all shown that banks with more risky assets tend to securitize more, to address such high risk exposures. Meanwhile, Sakrisyan, Casu, Clare & Thomas (2009) and Panetta & Pozzolo (2010) have found that banks that securitize have less risky profiles, as a result of the removal of risk in the securitization process. In this paper, we extend the discussion on securitization as a credit risk management tool, by looking at how securitization may affect the bank's loan portfolio. More specifically, we investigate how securitization, as a vent for risk, may affect the composition and size of the loan portfolio of the bank. At the same time, we also examine what does such changes in the loan portfolio imply on the risks and returns that the bank eventually faces. Further, we also take a look if the changes in the bank's loan portfolio (as affected by securitization) may impact its diversification and if this entails the benefits of diversification (i.e. reduced portfolio risk and less volatile returns).

Using data on 129 member-banks of the Federal Deposit Insurance Company (FDIC) from 2004-2010, we find that securitization is positively related to the portfolio share of Consumer Loans. This implies that the usage of securitization as a credit risk management tool, leads to the bank experiencing changes in its loan portfolio

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composition, that goes towards having more Consumer Loans. At the same time we find that securitization is also positively related to loan portfolio size, which may be traced to the increase in the holdings of Consumer Loans, observed previously.

In our subsequent analysis on the risk and the returns of the bank, our results show that securitization is positively related to the overall risk of the loan portofolio of the bank. This means that securitization, as a vent for risk, may actually increase the risk exposures of the bank (and not necessarily tone it down). This may be explained by our earlier findings, where securitization increases the holdings of Consumer Loans, which are considerably the riskiest loans class the banks can hold, and that securitization also increases the size of the loan portfolio. This increase in risk exposure from securitization, however, rewards the bank with higher returns (although such higher returns may be volatile).

With the shuffling of the loan portfolio towards Consumers Loans, our investigation on the effect of securitization on the diversification of the loan portfolio yields that securitization may make the loan portfolio of the bank more diversified. In addition, we find that the diversification of the bank's loan portofolio, also gives it the positive effects diversification, which are reduced portfolio risk and more stable returns. We take these effects as benefits that offset the risky effects of securitization found in the earlier analysis, and a motivation for banks for their continued use of securitization as a means for credit risk management.

The main contribution of our study accrues to the literature on securitization as a risk management tool, where we show that securitization may not necessarily be used for absolute risk isolation or reduction. Theory and earlier empirical work[1] show that securitization can be used to offload risk, and results to the bank having less exposure to risk. Instead, our study points out that securitization is a risk management tool in the sense that it can be used by banks to take on more credit risk, possibly in pursuit of higher yields . At the same time, our study also contributes to the ongoing discussions on the value of securitization. Following its involvement in the recent financial crisis, securitization has had an unfavourable reputation. By showing that securitization has risk-taking, profit-augmenting and diversification effects, our study points out that securitization may still have some significance.

The rest of our paper is organized as follows; Section 2 gives a review of the literatrure related to our study. Section 3 provides a discussion on the credit risk management property of securitization and our preliminary data analysis, which sets up our hypothesis. Sections 4 and 5 presents our empirical analyses. Section 6 concludes.

2. Literature Review

Our study is primarily related to Cebenoyan & Strahan (2004) that looks into bank engagement in loan sales which is an analogue to securitization[2]. Cebenoyan & Strahan (2004), has observed that banks that actively sell their loans increase their risky loans holdings in the form of Commercial Real Estate Loans and Commercial and Industrial (C&I) Loans. In other words, the study has found that loans sales shifts the composition of the bank's loan portfolio towards more risky loans. At the same time, the study has observed that the risky loan holdings brought about by

loans sales do not have an effect on the risk profile of the bank's loan portfolio nor on its returns. The conclusion that may be drawn from the study is thus, that loan sales serve as a credit risk management tool for the bank, wherein it allows the bank to take on higher risk, without exacerbating its overall risk profile, nor compromising its returns. In our study, we innovate on the above work by having securitization as the credit risk management tool, instead of loans sales.

On studies that look into securitization as a means for credit risk management, our study is related to Goderis, Marsh, Costello & Wagner (2007), Dione & Harchaoui (2003) and Loutskina (2011). Goderis et. al. (2007), has found that securitization[3] allows banks to relieve themselves of risk constraints, such that they can increase their targeted level of loans, and increase their interest income from such bigger loan portfolio. Dione & Harchaoui (2003), on the other hand, has pointed out that increasing levels of securitization tend to increase the risk-weighted assets to assets ratio among Canadian banks, implying that securitization permits banks to expand to risky loans. We take a further step from these works by showing the specific direction of risk taking that banks follow with securitization that is towards having more risky Consumer Loans, and where such risky exposures allow them to realize higher returns. Meanwhile, Loutskina (2011) has shown that banks with more securitizable[4] loan portfolios can continue to take in high risk (and illiquid) loans, and even increase this lending during periods of funding shocks. Our study parallels this work in the sense that we show that actual securitization (instead of securitizability) does allow banks to expose themselves to more risky loans.

In addition, our study is also connected with Pavel & Phillis (1987) and Panetta & Pozzolo (2010), through our examination on the diversification effect of securitization. Pavel & Phillis (1987) has found that banks participate in loan sales to have more diversified loan portfolios. On the other hand, Panetta & Pozzolo (2010) has observed that banks that securitize, have loan portfolios that are more equally distributed among mortgages, leases and other loans. In our study, we look at diversification as affected by securitization in another way, which is the distribution of the bank's loan portfolio across different loans classes.

3. Preliminary Analysis and Hypothesis

As discussed in the introduction, the credit risk management property of securitization lies on the transfer of the loans that are being securitized to the SPE. This is because the movement of the securitized loans implies the offloading of risk in the securitization process. It is also pointed out in the introduction that a number of studies have shown that banks do try to make use of this credit risk management property of securitization. In this study, we go forward by looking at how such employment of securitization as a vent for risk, may affect the loan portfolio of the bank.

Using data on Securitization Activity[5] for 129 member-banks of the FDIC from 2004-2010, we begin our analysis by looking at how engagements in securitization may affect the composition of the bank's loan portfolio. To do this, we first group our banks according to the intensity of their securitization activities. We create three bank groups namely the High, Mid and Low-Securitizers[6]. For each bank group, we take the mean portfolio share of the major loans classes that our sample banks can

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hold[7]. These loans classes are; Real Estate, Commercial and Industrial (C&I), Consumer, Farm and Others[8]. The clear observation we make from the above exercise is that the portfolio share of Consumer Loans (Real Estate Loans) is bigger (smaller), as banks get into more securitization engagements (see Table 1). This gives us the impression that the portfolio holdings of Consumer Loans increases with securitization activity, while that of Real Estate Loans decreases. In addition, considering that Real Estate Loans are the most securitized loans by banks, while Consumer Loans are securitized less (see Figure 1), we take that banks may have increased their Consumer Loans holdings, through the securitization of Real Estate Loans.

Table 1. Summary Statistics

Sampling Period: 2001:4-2010:4, No. Of Banks: 129, No. of Banks in Each Group: 43	Volume of Bank Assets Sold & Securitized/Assets (Securitization)		
	Low-Securitizers (Sec ≤ 33rd Percentile)	Mid-Securitizers (33rd Percentile<Sec≤ 67th Percentile)	High-Securitizers (67th Percentile< Sec)
	1	2	3
Real Estate Loans/Loans	62.434	57.585	45.991
C&I Loans/Loans	23.668	20.940	17.047
Consumer Loans/ Loans	8.230	9.637	26.774
Farm Loans/ Loans	0.554	0.425	0.588
Other Loans/ Loans	5.185	11.441	9.633
Loans/Assets	59.929	64.019	64.126
Log of Assets	16.338	16.674	17.522
CAR	10.266	11.401	12.374
Core Deposits/Assets	58.062	51.734	43.220
1-HHI	0.433	0.454	0.453
NPLs/Total Loans	1.310	2.106	2.025
SD NPLs	0.290	0.523	0.369
Charge-Offs/Total Loans	0.563	0.920	1.667
SD Charge-Offs	0.168	0.218	0.205
ROA	0.880	0.769	1.180
SD ROA	0.200	0.425	0.394
ROE	9.809	7.613	10.576
SD ROE	2.039	3.830	3.692

Table 1 Notes: Balance sheet data are taken from the FDIC Quarterly Call Reports. 1-HHI is the inverse of the Herfindahl-Hirschman Index, serving as indicator for loan portfolio diversification. The standard deviations (SDs) are calculated for each year using quarterly values.

Subsequently, we take a look at the effect of securitization activity on loan portfolio size. We do this by taking the mean Loans/Assets ratio of each of our banks groups. We observe that banks that securitize more (i.e. banks with medium to high levels of securitization activity) have relatively bigger loan portfolio size, than those that securitize less (see Table 1). We may trace such larger loan portfolio size among the more-intense securitizing banks, from their increased portfolio holdings of Consumer Loans observed earlier.

Figure 1. Share of Securitized Loans to Total Loans Outstanding by Loans Class (2001-2010)
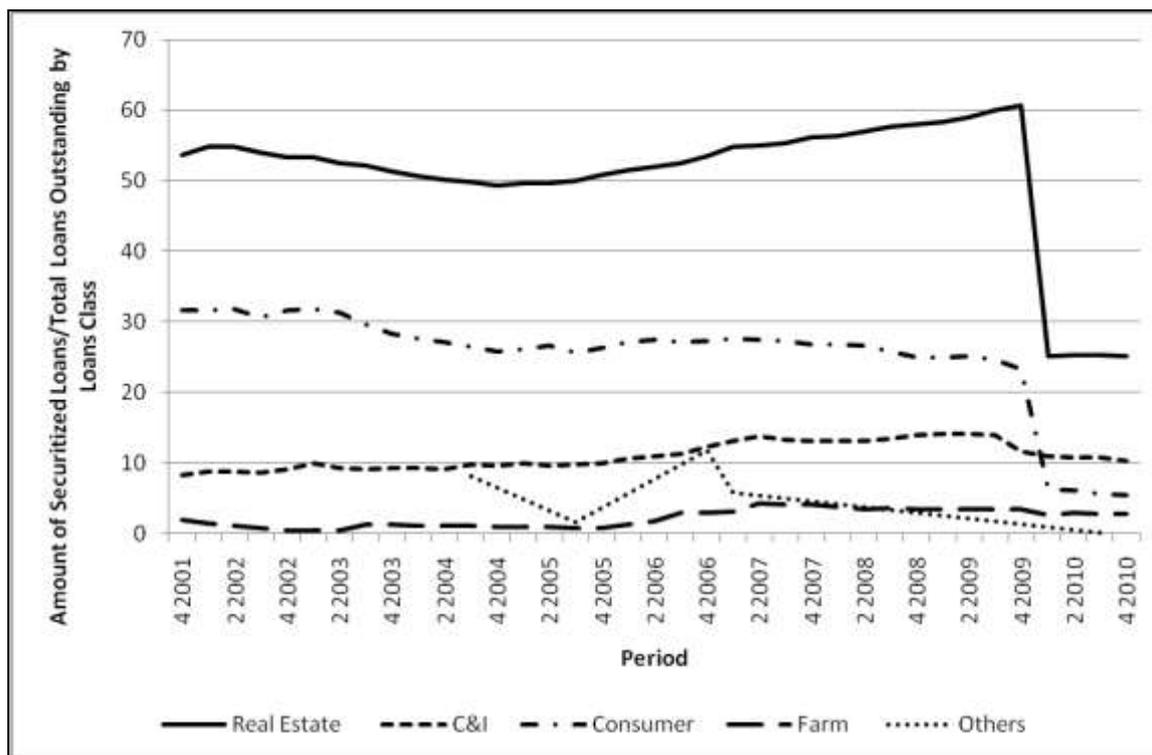

Figure 1 Notes: The share of Securitized Loans to Total Loans Outstanding of each Loans Class is calculated as the ratio of the Amount of Securitized Loans of each Loans Class to the Total Amount of Loans of each Loans Class (e.g. Share of Securitized Real Estate Loans = Amount of Real Estate Loans Securitized/Total Real Estate Loans Outstanding). Data used for the calculation of figures plotted above are taken from the Flow of Funds Account of the United States, Federal Reserve Board.

Our above findings may be attributed to the attempt among banks of managing their credit risk exposures, as they take in Real Estate Loans and Consumer Loans and with securitization as the means for such risk management. To see this point more clearly, we can begin by considering that banks may want to exploit economies of scope in borrower screening and monitoring, and they do so by offering Real Estate Loans (i.e. Mortgages) and Consumer Loans, as a bundle to each of their clients[9]. As a bank adopts this practice, what the bank may then need to ultimately decide on, is how many of the bundles it will offer. However, considering that Real Estate Loans and Consumer Loans have a high positive covariance of risk (see Table 2)[10], Value-at-Risk Constraints may put a limit on the amount of bundles that the bank can sell. Nonetheless, if the bank can lower some of the risk in each bundle, it may be able to offer more bundles. This is possible through the securitization of one of the loans that forms part of the bundle. That is, by securitizing the Real Estate Loan which partially comprises the bundle[11], the bank gets to tone down the risk of the bundle, allowing it to sell more bundles. As the bank sells more bundles, the bank then ends up with more Consumer Loans in its loan portfolio and this holding of more Consumer Loans increases the size of the bank's loan portfolio.

Given these points from our preliminary analysis, we may then consider the idea that engagement of the bank in securitization for credit risk management purposes[12], may lead to the bank having a portfolio with more holdings of Consumer Loans. At the same time with more Consumer Loans in the bank's loan portfolio, as it securitizes, the bank may also experience an increase in loan portfolio size.

Table 2. Covariance Matrix of Defaults among Different Loans Classes (2001-2010)

	Farm	C&I	Consumer	Others
Real Estate	0.1436186	0.0604956	0.1908590	0.0314621
Farm		0.0389255	0.0779504	0.0036428
C&I			0.0361855	0.0029371
Consumer				0.0127283

The covariances are calculated using the default rates in Figure 2. The range for the calculation of the covariances is based in the sample period of 2001:4-2010:4.

4. Empirical Analysis

Based on the previous section, the hypothesis we then have to test is that, as the bank securitizes (to manage its credit risk exposures), the bank may experience an increase in its portfolio holdings of Consumer Loans, as well as an increase the size of its loan portfolio. In testing this inference, we implement two sets of empirical estimations. First, we examine the relationship between securitization and the portfolio share of Consumer Loans, to verify the point that securitization may lead to more holdings of Consumer Loans. Second, we take a look at the relationship between securitization and loan portfolio size to establish if the increased holdings of Consumer Loans, through securitization, may indeed also result to a larger loan portfolio.

As mentioned earlier, the data we use in our analysis are data on member-banks of the FDIC. Banks under the FDIC submit Call Reports on a quarterly basis, which are accessible at the FDIC website. The Call Reports are a rich source of bank balance sheet data, including data on the loan portfolio of the bank, as well as, data on the securitization activities of the bank. As such, the Call Reports provide us the vital data we need for our estimations. FDIC-member banks have been required to report their securitization engagements in the Call Reports beginning 2004:1. Thus, we take 2004:1 as the start date of our sample period. Since 2004:1, there have been 129-member banks that have been reporting their securitization activities. These 129 banks are then the banks that are relelvant to our analysis and consequently form our sample banks. We end our sample period at 2010:4, which is the latest period with accessible Call Reports.

In implementing our estimations, we use the specification employed in Cebenoyan & Strahan (2004), cited in Section 2. However, instead of loans sales as the credit risk management tool, we have securitization engagements. Our specification is thus as follows:

$$Y_{it} = \alpha_o + \alpha_1 Securitization_{it-1} + \beta X_{it-1} + \varepsilon_{it} \tag{1}$$

where: Y_{it} = Portfolio Share of Consumer Loans/Loan Portfolio Size of bank i at the end of quarter t; $Securitization_{it-1}$ = Securitization Activity of bank i at the beginning of quarter t; and X_{it-1} = vector of bank-specific control variables of bank i at the beginning of quarter t.

To measure the Portfolio Share of Consumer Loans, we take the ratio of Consumer Loans to Total Loans (i.e. *Consumer Loans/Loans*), while as indicator for Loan Portfolio Size, we take the Total Loans to Total Assets ratio (i.e. *Loans/Assets*) .

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Meanwhile, our proxy for Securitization Activitiy (i.e. *Securitization*) is the total reported Bank Assets Sold & Securitized normalized by Total Assets. We have in our preliminary analysis and in our hypothesis, that as the bank securitizes for credit risk management reasons, it ends up with more holdings of Consumer Loans as well as a larger portfolio size. Thus we expect, that *Securitization* must be positively related to both *Consumer Loans/Loans* and *Loans/Assets* (i.e. $\alpha_1 > 0$ in both estimations).

To account for the other factors that may have an influence on the bank's loans holdings, we add bank-specific control variables in our specification. The bank-specific factors we consider are Bank Size (measured through the Log of Assets), Capitalization (measured through the Capital-to-Assets Ratio (CAR)) and the size of the bank's Traditional Funding Base (measured through Core Deposits/Assets). We also take into account if the bank operates within only one state or region (Local Bank Dummy=1, 0 otherwise) and if the bank is affiliated to a foreign bank holding company (Foreign Bank Dummy=1, 0 otherwise), as these characteristics may also have an influence on the size of the bank's loan portfolio[13]. The summary statistics of the control variables involved in our estimations are also reported in Table 1. However, for reasons of brevity, we skip an analytical discussion of the summarry statistics of these control variables.

In executing our specifications, we employ bank fixed effects (FE) and panel instrumental variables (IV) regressions. In our IV regressions, we use as instruments the previous period's[14] Securitization Activity, Bank Size, Capitalization and Traditional Funding Base. Moreover, we also use as instruments a measure for the extent of Credit Enhancements[15] that a bank offers on its securitization transactions, as well as, a measure for the riskiness of the loans that the banks have securitized[16]. The previous period's Securitization Activity, Credit Enhancements and riskiness of securitized loans affects our dependent variables (i.e. *Consumer Loans/Loans$_{it}$* and *Loans/Assets$_{it}$*), only through our main explanatory variable[17] (i.e. *Securitization$_{it-1}$*). Maintenance of our results from the FE estimations under our IV estimations, will then rule out the issue of reverse causality between securitization and loan portfolio size.

In addition to using the two above estimation processes, we also execute our specification under three different periods. The first period we consider encompasses our entire sample period from 2001:4-2010:4. For the second period, we consider only 2001:4-2009:2 (which is the period when securitization has been popularly practiced by banks), while the third period concerns only 2009:3-2010:4 (which is the period when banks have mainly shied away from securitization[18]). We differentiate between these periods to be able to establish if, even at the time when securitization has already been unpopular due to its entanglement with the subprime crisis, banks can still use it to be able to hold more loans.

Our estimation results for Securitization and the portfolio share of Consumer Loans are reported in Panel 1 of Table 3 and in Panel 1 of Table 4. Both the FE and IV estimation results are presented in Tables 3 & 4. In Table 3 the results concern the entire sample period of 2001:4-2010:4, while in Table 4 the results are differentiated according to when securitization was in favour (2001:4-2009:2) and when it has been less so (2009:3-2010:4). We find in both FE and IV estimations in Panel 1 of Table 3 that *Securitization* is positively related to *Consmer Loans/Loan*s, as expected. Our

results show that this effect of *Securitization* is, as well, statistically and economically significant. This finding establishes the first part of our hypothesis which posits that as banks securitize for credit risk management purposes, the banks end up having more holdings of Consumer Loans in their portfolios. In Panel 1 of Table 4, we see that this point applies in both periods when securitization was popular and when it was otherwise. We find that in both differentiated periods, the FE and IV estimations still show a positive relationship between *Securitization* and the portfolio share of Consumer Loans.

Table 3. Securitization and the Bank Loan Portfolio (Entire Period)

	Dependent Variable			
	Consumer Loans/Loans$_t$		Loans/Assets$_t$	
	1		2	
Sampling Period: 2001-2010	FE	IV	FE	IV
Independent Variables				
Securitization$_{t-1}$	0.428***	0.475***	0.081***	0.086***
	(32.356)	(36.663)	(8.706)	(6.950)
Log of Assets$_{t-1}$	-0.001	0.001	-0.047***	-0.038***
	(-0.523)	(0.015)	(-20.243)	(-6.696)
CAR$_{t-1}$	0.354***	0.805***	0.476***	0.628***
	(12.870)	(14.003)	(13.961)	(11.481)
Core Deposits/Assets$_{t-1}$	-0.058***	-0.091***	-0.001	0.019
	(-11.312)	(-5.742)	(-0.071)	(1.259)
Local Bank Dummy	Yes	Yes	Yes	Yes
Foreign Bank Dummy	Yes	Yes	Yes	Yes
No. of Observations	3982	3982	3982	3982
No. of Banks	129	129	129	129
R-Squared	0.435	0.426	0.378	0.167

Table 3 Notes: The dependent variable in Panel 1 is the Portfolio Share of Consumer Loans. The dependent variable in Panel 2 is Loan Portfolio Size. FE refers to Bank Fixed Effects estimation results, while IV refers to the Panel Instrumental Variables estimation results.The main independent variable for all sets of estimations is *Securitization*. Items in parenthesis report the t-statistics. * denotes significance at the 10% level, ** at the 5% level and, ***at the 1% level. All regressions include an intercept.

Going through our control variables, the robust and economically significant relationships to *Consumer Loans/ Loans* that we find are those on Capitalization and Core Deposits/Assets. We have in the results of both Panel 1 of Table 3 and Panel 1 of Table 4 that CAR is positively related to *Consumer Loans/Loans*. This result points out the importance of capital adequacy in bearing more loan exposures. Meanwhile, *Core Deposits/Assets* is negatively related to *Consumer Loans/ Loans* in all our estimations. This implies that banks relying much on traditional funding may not grant and hold much Consumer Loans. This can be explained by the banks creating a mismatch on their assets and liabilities to manage cash flows, since both Core Deposits and Consumer Loans are retail in nature[19].

On the relationship between Securitization and loan portfolio size, our estimation results are reported in Panel 2 of Table 3 and Panel 2 of Table 4. Both the FE and IV estimation results in Panel 2 of Table 3 show a positive relationship between *Securitization* and *Loans/Assets.* The results in Panel 2 of Table 3 also show that the relationship found is statisically and economically significant.This provides a confirmation for the second part of our hypothesis, where we pose that as banks securitize to manage their risk exposures and resultantly have more Consmer Loans holdings, they also experience an increase the size of their loan portfolios. In

addition, our results in Panel 2 of Table 4, show that this point holds in both periods when securitization was highly practiced and when it was not.

Table 4. Securitization and the Bank Loan Portfolio (Differentiated Periods)

	Dependent Variable							
	Consumer Loans/Loans$_t$				Loans/Assets$_t$			
	1				2			
Sampling Period	2001:4-2009:2		2009:3-2010:4		2001:4-2009:2		2009:3-2010:4	
	FE	IV	FE	IV	FE	IV	FE	IV
Independent Variables								
Securitization$_{t-1}$	0.489***	0.489***	0.282***	0.467***	0.071***	0.069***	0.139***	0.288***
	(48.121)	(38.118)	(5.176)	(5.294)	(7.635)	(5.399)	(13.526)	(4.075)
Log of Assets$_{t-1}$	-0.007***	-0.004	0.019***	0.012	-0.043***	-0.031***	-0.058***	-0.058***
	(-3.498)	(0.642)	(5.194)	(0.583)	(-16.912)	(-5.001)	(-18.606)	(-3.357)
CAR$_{t-1}$	0.384***	0.715***	0.598***	1.057***	0.497***	0.660***	0.518***	0.531**
	(12.854)	(12.100)	(9.949)	(4.174)	(14.662)	(11.128)	(7.066)	(2.614)
Core Deposits/Assets$_{t-1}$	-0.062***	-0.073***	-0.242***	-0.262***	-0.002	0.010	0.014	0.024
	(-12.075)	(-4.383)	(-17.946)	(-4.700)	(-0.185)	(0.620)	(0.891)	(0.529)
Local Bank Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Foreign Bank Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of Observations	3275	3275	707	707	3275	3275	707	707
No. of Banks	129	129	129	129	129	129	129	129
R-Squared	0.558	0.478	0.865	0.245	0.558	0.181	0.724	0.100

Table 4 Notes: The dependent variable in Panel 1 is the Portfolio Share of Consumer Loans. The dependent variable in Panel 2 is Loan Portfolio Size. Estimations for the dependent variables are differentiated into two periods, namely 2001:4-2009:2 and 2009:3-2010:4. The period of 2001:4-2009:2 pertain to the period when securitization has been highly practiced by banks. On the other hand, the period 2009:3-2010:4 refers to the period when banks have engaged less in securitization, as the activity has fallen out of favour due to its involvement with the subprime crisis. FE refers to the Bank Fixed Effects estimation results, while IV refers to the Panel Instrumental Variables estimation results. The main independent varialbe for all sets of estimations is *Securitization*. Items in parenthesis report the t-statistics. * denotes significance at the 10% level, ** at the 5% level and, ***at the 1% level. All regressions include an intercept.

On the control variables all our results in Panel 2 of Table 3 and Panel 2 of Table 4, show that *Log of Assets* is negatively related to *Loans/Assets*. Though this may be an unexpected result, this can be explained by big banks being more involved in other activities such as fee-based services (e.g. securities underwriting, loan syndication, etc.). Involvement in these other activities tends to compromise the bank's interest-income driven activities, specifically, loans. Hence, the negative relationship observed between loan holdings and bank size. On the other hand, the CAR comes out positively related to *Loans/Assets*, also in all estimations reflected in Panel 2 of Table 3 and Panel 2 of Table 4. This result is straightforward, as more capitalized banks are more capable of bearing loans.

With our findings above, we prove the two points of our hypothesis. These points are that as banks use the credit risk management property of securitization, they end up with more holdings of Consumer Loans and, in effect, also a larger loan portfolio. In the following analyses, we investigate at how securitization (through the changes it has brought on the bank's loan portfolio) may affect the overall risk of the loan portfolio of the bank, as well as, the returns that the bank eventuallly reaps. Further, we also examine if the changes that securitization brings on the bank's loan portfolio, may also impact on the diversification of the loan portfolio and if this entails the classical diversification benefits of reduced portfolio risk and more stable returns.

5. Further Analyses

5.1 Securitization, Loan Portfolio Risk and Bank Returns

We have found that securitization, used as a vent for risk, has an impact on the bank's loan portfolio composition and size. Since the composition and size of the loan portfolio, in turn, determine the bank's risk profile and the returns it gains, these may also then be affected by securitization. This may especially be the case given that, as observed, banks get to hold more Consumer Loans with securitization and that Consumer Loans are the riskiest loans class that the banks can hold. The high-risk nature of Consumer Loans relative to other loans classes may be seen in Figure 2, which plots the default rates of our different loans classes for our entire sample period. We can observe from Figure 2 that Consumer Loans have the highest default rates among the different loans classes for most of our sample period[20].

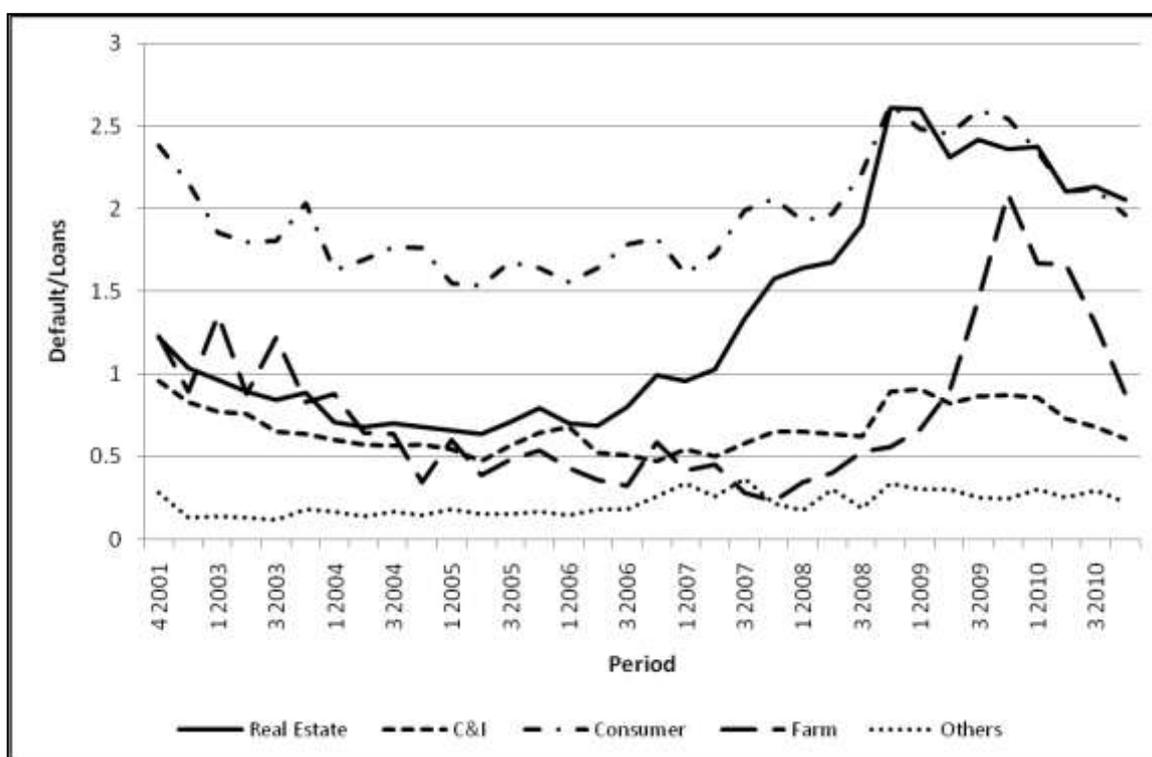### Figure 2. Default Rates by Loans Class (2001-2010)

Figure 2 Notes: The default rate of each Loans Class is calculated as the ratio of the Amount of Loans of each Loans Class that is in Default to the Total Amount of Loans of Each Loan Class (e.g. Default Rate of the Real Estate Loans=Real Estate Loans in Default/Total Amount of Real Estate Loans). The default rates are calculated based on the aggregate values for the entire Commercial and Thrift Banking System under the FDIC. Data on aggregate values for the Commercial and Thrift Banking System are accessible through the Statistics on Depository Institutions available at the FDIC website.

To look at the relationship between securitization and the overall risk of the bank's loan portfolio, we implement the same specification used in Cebenoyan & Strahan (2004) in looking the effect of loans sales on the portfolio risk of the bank. However, as we have done earlier, we substitute the variable of loans sales with securitization activity. Our specification is as follows:

$$Y_{it} = \alpha_o + \alpha_1 Securitization_{it-1} + \beta X_{it-1} + \phi Z_{it-1} + \varepsilon_{it} \qquad (2)$$

where: Y_{it} = Overall Loan Portfolio Risk of bank *i* at the end of quarter *t*; $Securitization_{it-1}$ = Securitization Activity of bank *i* at the beginning of quarter *t*; X_{it-1} = vector of bank-specific control variables of bank *i* at the beginning of quarter *t*; and Z_{it-1} = vector of shares of each loans class in the loan portfolio of bank *i* at the beginning of quarter *t*.

We take four measures of loan defaults to stand as indicators of overall loan portfolio risk. These are; a. the Non-Performing Loans[21] to Total Loans Ratio (i.e. *NPLs*); b. the standard deviation of *NPLs*[22] (i.e. S*D NPLs*); c. the Loan Charge-Offs[23] to Total Loans Ratio (i.e. *Charge-Offs*); and d. the standard deviation of *Charge-Offs*[24] (*SD Charge-Offs*).

For the bank-specific control variables, we include the same control variables for Bank Size and Capitalization plus a control variable for Loan Portfolio Size, measured by Total Loans normalized by Total Assets (i.e. *Loans/Assets*). We control for Loan Portfolio Size, as this variable may have an influence on the incidence of loan defaults (which we use as indicators for loan portfolio risk). Like in our previous estimations we also take into account the geographical confinement of the bank's operations and its affiliation to a foreign bank holding company.

In our specification, we also include variables controlling for the shares of each loans class in the banks' respective loan portfolios (vector-*Z*). We include this set of control variables considering that each loan class have varying risks and may therefore have different impacts on the incidence of loan defaults. To avoid perfect collinearity, we exclude the portfolio share of Other Loans (i.e. *Other Loans/Loans*).

Going back to Table 1, we see in our summary statistics that our indicators of loan portfolio risk are generally higher for banks that securitize more (i.e. those in the Mid and High-Securitizers Group), than those that securitize less (i.e. those in the Low-Securitizers Group). This gives us the impression that overall loan portfolio risk may increase with securitization. In Table 5, we get a verification of this notion where we find a positive relationship between *Securitization* and all our measures of loan portfolio risk. As reported in Table 5, securitization is statistically and economically significant in most of our estimations except that of SD Charge-Offs. These results point out that altough securitization may have been used to unload risk, it still leads to the bank having more credit risk exposures, through the increase in risky Consumer Loans holdings and the increase in loan portfolio size that it brings about.

On the control variables, Banks Size, Capitalization and Loan Portfolio Size are chiefly positively related to overall loan portfolio risk. Bigger and more capitalized banks as well as banks with larger portfolios do tend to take on more risk. Hence, such variables are bound to be positively related with loan portfolio risk. Meanwhile, the respective portfolio shares of the different loans classes are also mostly positively related to all the measures of overall loan portfolio risk. This result is immediate, as every loans class must pose some risk to the loan portfolio of the bank.

Table 5. Securitization and Overall Loan Portfolio Risk

	Dependent Variable			
	NPLs$_t$	Charge-Offs$_t$	SD NPLs$_t$	SD Charge-Offs$_t$
Sampling Period: 2001:4-2010:4	1	2	3	4
Independent Variables				
Securitization$_{t-1}$	0.786***	0.917***	0.141***	0.023
	(10.624)	(8.240)	(4.003)	(0.887)
Log of Assets$_{t-1}$	0.917***	0.326***	0.100***	0.021***
	(22.872)	(17.296)	(5.400)	(2.709)
CAR$_{t-1}$	1.670***	0.366	0.723***	0.092
	(5.409)	(1.503)	(4.746)	(0.907)
Loans/Assets$_{t-1}$	1.045***	0.882***	0.108*	0.046
	(9.145)	(12.561)	(1.698)	(1.503)
Real Estate Loans/Loans$_{t-1}$	1.276***	0.224***	0.145*	0.047
	(9.181)	(3.025)	(1.913)	(1.293)
C&I Loans/Loans$_{t-1}$	1.099***	0.745***	0.156*	0.154***
	(7.304)	(7.165)	(1.681)	(3.428)
Consumer Loans/Loans$_{t-1}$	0.369**	2.579***	-0.135*	0.218***
	(2.445)	(20.083)	(-1.648)	(4.964)
Farm Loans/Loans$_{t-1}$	4.463***	-0.236	0.841	0.296
	(4.678)	(-0.279)	(1.609)	(0.819)
Local Bank Dummy	Yes	Yes	Yes	Yes
Foreign Bank Dummy	Yes	Yes	Yes	Yes
No. of Observations	3982	3982	971	971
No. of Banks	129	129	129	129
R-Squared	0.230	0.317	0.092	0.071

Table 5 Notes: The above results are obtained using Bank Fixed Effects estimations.The dependent variables in Panel 1-4 are various measures of Loan Defaults, standing as proxies for Overall Loan Portfolio Risk. The main independent variable for all sets of estimations is *Securitization*. Items in parenthesis report the t-statistics. * denotes significance at the 10% level, ** at the 5% level and, ***at the 1% level. All regressions include an intercept.

Finding that securitization may increase the overall loan portfolio risk, we examine next if such may reward the bank with higher returns[25]. To do so, we reestimate Equation (2) with the bank's returns as dependent variable (i.e. $Y_{it} =$ Returns of bank *i* at the end of quarter *t*). We measure bank returns in two dimensions namely the actual returns of the bank and the stability of these returns. Our measures for the actual bank returns are the Return-on-Assets (ROA) and the Return-on-Equity (ROE), while for the stability of bank returns, our indicators are the respective standard deviations of the ROA and ROE (SD ROA and SD ROE)[26]. The higher the SD ROA or the SD ROE, the less stable are the bank returns.

Looking at the summary statistics of our variables for bank returns in Table 1, we find some evidence that the increase in risk taking through securitization may be accompanied by higher bank returns. We observe that the ROA and the ROE for High-Securitizers are markedly higher than that of Mid-Securitizers and Low-Securitizers. However, it also seems that these high returns may not be accompanied with more stable bank returns, as the SD ROA and the SD ROE appear higher for the groups of banks that securitize more.

We get a clearer picture of the relationship between securitization and bank returns from our estimation results in Table 6. In Panels 1 & 2 of Table 6, we find that *Securitization* is positively related to both the ROA and ROE and is also statistically and economically significant in both estimations. These findings imply that as

securitization exposes the bank to more risk, it also presents the bank with higher returns. Going through the other control variables, we have that bank size and capitalization are negatively related to bank returns, pointing out that big and more capitalized banks are not necessarily the most profitable. This may be once again due to the tendency of most of these banks to go into other activities, where these activities may not be very high-yielding (e.g. fee-based services). Loan portfolio size, on the other hand, is positively related to both the ROA and ROE. These results are driven by the large interest income that is derived from a big loan portfolio.

Table 6. Securitization and Bank Returns

	Dependent Variable			
	ROA_t	ROE_t	SD ROA_t	SD ROE_t
Sampling Period: 2001:4-2010:4	1	2	3	4
Independent Variables				
Securitization$_{t-1}$	0.858***	4.935***	0.251***	1.672***
	(9.264)	(6.208)	(4.640)	(4.371)
Log of Assets$_{t-1}$	-0.285***	-2.875***	-0.008	-0.031
	(-16.017)	(-15.165)	(-0.737)	(-0.265)
CAR$_{t-1}$	-1.177***	-67.438***	0.098	-9.307***
	(-4.581)	(-30.092)	(0.572)	(-7.489)
Loans/Assets$_{t-1}$	0.346***	5.053***	0.236***	0.649
	(4.514)	(6.207)	(4.843)	(1.413)
Real Estate Loans/Loans$_{t-1}$	-0.817***	-11.627***	-0.357***	-2.589***
	(-8.100)	(-11.518)	(-4.445)	(-3.817)
C&I Loans/Loans$_{t-1}$	-0.148	-7.164***	-0.239**	-3.570***
	(-1.123)	(-5.213)	(-2.340)	(-4.014)
Consumer Loans/Loans$_{t-1}$	0.371***	-0.901	-0.222**	-1.381**
	(3.102)	(-0.818)	(-2.461)	(-1.992)
Farm Loans/Loans$_{t-1}$	-2.211***	-18.823***	-0.792	-1.222
	(-3.316)	(-2.877)	(-1.533)	(-0.444)
Local Bank Dummy	Yes	Yes	Yes	Yes
Foreign Bank Dummy	Yes	Yes	Yes	Yes
No. of Observations	3982	3982	971	971
No. of Banks	129	129	129	129
R-Squared	0.178	0.301	0.098	0.096

Table 6 Notes: The above results are obtained using Bank Fixed Effects estimations.The dependent variables in Panels 1 & 2 are, respetively, the ROA and the ROE, serving as measures for actual bank returns. In Panels 3 & 4, the dependent variables are, the standard deviations of the ROA and the ROE (SD ROA and SD ROE), standing as proxies for bank returns volatility. The main independent varialbe for all sets of estimations is *Securitization*. Items in parenthesis report the t-statistics. * denotes significance at the 10% level, ** at the 5% level and, ***at the 1% level. All regressions include an intercept.

Meanwhile, Panels 3 & 4 show that securitization is positively related to the *SD ROA* and the *SD ROE*, or that securitization can lead to unstable bank returns. These results may be due to the risky source of the high returns provided by securitization, which is that of increasing the portfolio share of risky Consumer loans. The implication of this finding is that although the higher risk exposures are accompanied by high returns, the instability of such returns may pose a concern to the bank. This concern could sequentially compromise the bank's interest in continuing to engage in securitization for credit risk management purposes. In such a situation, a certain windfall that would convince the bank to sustain its securitization activities may be necessary. We find this windfall as we look into the diversification effects of securitization which we discuss in the following section.

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5.2 Securitization and Loan Portfolio Diversification

Our earlier finding which shows that securitization shuffles the composition of the bank's loan portfolio towards more Consumer Loans, brings the possibility that securitization may also have an impact on the diversification of the bank's loan portfolio. Given that diversification has implications on the risk of the bank's loan portfolio, as well as its returns, we also look into this issue as a further analysis. The classical hypothesis of diversification posits that by spreading a portfolio into different assets (in our case, loans) with uncorrelated risks, the risks may cancel each other out. As such, diversification may reduce the overall risk of the loan portfolio and that the risk-reduction could also lead to more stable returns. In Acharya, Hasan & Saunders (2002), this hypothesis has been partly verified by results that among Italian banks, the banks that diversify their loans on different sectors have lower NPLs (i.e. lower risk).

If we look back at our summary statistics in Table 1, we may observe that securitization, to some degree, could lead to a more diversified loan portfolio. As we move from the Low-Securitizers Group to the High-Securitizers Group, we see a relatively more even distribution in the portfolio shares of each loans class. For example, Low-Securitizers, on average, hold a large chunk of their loans in Real Estate Loans at 62%, followed by C&I Loans at 24% and only a small portion of Consumer Loans at 8%. In contrast, High-Securitizers, have a relatively more balanced loan portfolio, where on average, the portfolio share of Real Estate Loans is at 45%, while that of the C&I Loans is at 17% and that of Consumer Loans is at 26%.

To further investigate this point, we take an indicator for loan portfolio diversification given by the inverse of the Herfindahl-Hirschman Index $(1-HHI)$[27]. The intuition of this index is that the higher it is, the more diverse is the loan portfolio. The average $1-HHI$ of our different bank groups are reported in Table 1. Both Mid-Securitizers and High-Securitizers have fairly higher mean diversification indicators than the Low-Securitizers. Given such, we move to confirm this observed case of securitization leading to loan portfolio diversification. To do so, we implement a panel estimation on $1-HHI_{it}$ against securitization. In this estimation, we include the same control variables used in Equation (1). At the same time, we add a one-period lagged value of the same indicator for loan portfolio diversification $(1-HHI_{it-1})$. The purpose of adding $1-HHI_{it-1}$ is to control for the likelihood that the bank may have already been diversifying its loan portfolio previously.

Our estimation results reported in the first row of Table 7[28] show that securitization may actually lead to loan portfolio diversification, with *Securitization* being positively related to $1-HHI$. We note that *Securitization* is statistically and economically significant in relation to the diversification indicator, even while considering for the strong reinforcing effect of the previous extent of loan portfolio diversification $(1-HHI_{t-1})$.

Given the above result, we next investigate if the bank reaps the known benefits of diversification, namely lower overall loan portfolio risk and more stable returns. In doing this, we estimate our measures of loan portfolio risk and our measures for

bank returns volatility against our diversification indicator $(1-HHI_{it-1})^{29}$, while controlling for securitization activity. We also include the control variables we have used in the estimation of Equation (2), except for the portfolio shares of the different loans classes, as these shares may already be accounted for by the diversification indicator[30].

Table 7. Securitization, Loan Portfolio Diversification, Risk and Returns

	Independent Variables		No. of Obs.	No. of Banks	R-Squared
	1-HHI$_{t-1}$	Securitization$_{t-1}$			
Sampling Period: 2001:4-2010:4	1	2			
Dependent Variables					
1-HHI$_t$	0.855***	0.019***	3982	129	0.976
	(107.307)	(3.832)			
NPLs$_t$	-0.782***	0.286***	3982	129	0.263
	(-4.098)	(4.576)			
Charge-Offs$_t$	-0.125**	1.730***	3982	129	0.219
	(-2.465)	(13.965)			
SD NPLs$_t$	-0.094*	-0.017	971	129	0.042
	(-2.428)	(-0.502)			
SD Charge-Offs$_t$	-0.051*	0.080***	971	129	0.043
	(-1.787)	(2.978)			
SD ROA$_t$	-0.160***	0.278***	971	129	0.111
	(-4.786)	(5.558)			
SD ROE$_t$	-2.129***	1.981***	971	129	0.137
	(-5.254)	(5.401)			

Table 7 Notes: The above results are obtained using Bank Fixed Effects Estimations. The dependent variables are on the first column (leftmost panel) of the Table. For brevity, only the main independent variables, 1-HHI$_{t-1}$ (in Panel 1) and Securitization$_{t-1}$ (in Panel 2) are reported. Items in parenthesis report the t-statistics. * denotes significance at the 10% level, ** at the 5% level and, ***at the 1% level. All regressions include an intercept.

Looking at our results on the second to the seventh rows of Table 7[31], we find that the banks do enjoy the beneficial effects of diversification. In Panel 1, we can see that $1-HHI_{t-1}$ is negatively related to our measures of loan portfolio risk, indicating that diversification lowers overall loan portfolio risk. At the same time, we can observe that the diversification indicator is negatively related to the SD ROA and the SD ROE, which means that diversification may stabilize bank returns. Meanwhile, in Panel 2 we see the same relationship we have found earlier between securitization and our variables for loan portfolio risk and bank returns stability. In the case of NPLs and SD NPLs, we see that the negative impact of $1-HHI_{t-1}$ is more economically significant than the positive impact of *Securitization*. These suggest that the diversification benefit of reduced overall loan portfolio risk, may effectively temper the increased risk brought about by securitization that results from the greater portfolio share of risky Consumer loans. Likewise, the negative effect of $1-HHI_{t-1}$ on SD ROE is more economically significant than the positive effect of *Securitization*. This points out that the instability of returns from securitization may also be mitigated by the diversification benefit of stable returns. Given these, we can consider that the diversification benefits could offset the undesirable effects of securitization. As such, banks receive the needed windfall to continue to engage in securitization for credit risk management purposes and enjoy the accompanying high returns that such strategy brings.

6. Concluding Remarks

Securitization serves the function of a credit risk management tool through the departure of loans from the bank's balance sheet to the SPE. In this paper, we investigate how the usage of securitization for purposes of credit risk management may afffect the composition and the size of the bank loan portfolio. Our results show, that as banks securitize to manage their credit risk exposures, they end up with more holdings of Consumer Loans and a larger loan portfolio size. We also find that as securitization effects these changes in the bank's loan portfolio, securitization also leads to the bank being more exposed to risk. At the same time, with these higher risk exposures, securitization also presents higher returns to the bank. With these, we may draw the insight that the usage of securitization for its credit risk management property may not necessarily be to reduce risk. Instead, banks may have used securitization as a facility to gain the flexibility take on more risk and possibly reap the higher gains associated with such higher risk exposures. While this strategy is indeed risky (as indicated by the increased volatility of returns we find in our latter analysis) and may raise some concerns for the bank, the bank encounters offsetting benefits from the diversification effects also brought by securitization. As such, the bank may be motivated to continue to securitize for credit risk management purposes and take advantage of the higher returns that such strategy offers.

In conclusion, our study thus points out that the usage of securitization for credit risk management goes beyond the mere offloading of credit risk. While we find that securitization has been used to manage credit risk, it has not been used as a means for absolute risk unloading[32]. Rather, it has been actually used as a means to be effectively more exposed to risk and enjoy the higher returns that accompany this move.

Endnotes

[1] Such as those mentioned in the earlier part of the introduction

[2] Like securitization, the loans are sold to third parties under loans sales and, hence, isolate the bank from the risk of these loans. The difference (among others) in the case of loans sales is that, the loans are sold directly to investors, which makes the investors' risk exposures contingent on the loans that they have respectively bought. On the other hand, in the case of securitization, the loans are sold to the SPE, which in turn, issues debt backed by the loans it has purchased, to the investors. In effect, the risk exposures of the investors in securitization rely on the pool of loans that backs the SPE-issued debt. Notwithstanding this difference, however, loans sales and securitization are, as mentioned, similar interms of the risk management property that they provide to banks.

[3] By means of issuing Collateralized Debt Obligations (CLOs)

[4] Loustkina (2011) measures loan portfolio securitizability as the size of the bank's loan portfolio multiplied by the depth of the securitization market of the bank's home economy.

[5] We measure our sample bank's Securitization Activity as the total reported Bank Assets Sold & Securitized normalized by Total Assets. All balance sheet data for this study are taken from the Call Reports that are submitted by our sample banks on a quartertly basis with the FDIC.

[6] High-Securitizers are banks whose Average Securitization Activity for the entire sample period rank above the 67th percentile among the 129 sample banks. Mid-Securitizers are banks whose Average Securitization Activity rank between the 33rd and 67th percentile. Low-Securitizers are banks whose Average Securitization Activity rank below the 33rd percentile.

[7] Portfolio Share of Loans Class X = Amount of Loans Class X in the Loan Portfolio/Total Loans

[8] The loans class "Others" are the Acceptances and Receivables Discounted by banks.

[9] This may have actually been done in practice as it is common to see banks offering its clients a combination of loans or credit. Examples of such are: a Housing Loan bundled with a Car Loan, a

Mortgage that also comes with a Credit Card Plan and a combination of a Home Equity Loan and a Personal Loan.

[10] As seen in Table 2, Real Estate Loans and Consumer Loans have, in fact, the highest positive covariance of risk among the different possible pairs of the major loans classes that the banks can hold.

[11] We note that the banks may opt to unload the Real Estate Loans (which forms part of the bundle) because Real Estate Loans are easier to securitize than that of Consumer Loans (which forms the other part of the bundle). The ease of securitizing Real Estate Loans comes from its collateralization. Since Real Estate Loans have collateral (i.e. the property), an investor in a securitization deal may find such a loan more appealing as an underlying asset, compared to one that has no collateral (e.g. a Consumer Loan). This is because should the loan (serving as underlying asset in the securitization transaction) be unable to successfully pay-off, the investor may still have some value from the deal through the collateral. It thus follows that a Real Estate Loan is easier to securitize, relative to the uncollateralized Consumer Loan.

[12] More specifically, to unload Real Estate Loans so that it is able lower the risk on the bundles it offers and gets to sell more of them.

[13] Local banks may have less market coverage than national banks and thus may have smaller loan portfolios. Foreign banks, on the other hand, due to their reputation and larger market coverage, may have larger loan portfolios.

[14] Given that we use a one-period lag on our independent variables, these instruments mentioned will take a two-period lag.

[15] Credit Enhancements are special features that banks may offer on their securitization transactions to make their deals more attractive. For a comprehensive discussion on Credit Enhancements and its various types, see Lea (2006). In this study, the Credit Enhancements that we consider are Subordinated Securitization and Lines of Credit. We measure the extent by which our sample banks offer these features by taking the ratio of the Amount of Credit Enhancements to the Total Amount of Securitized Loans (i.e. Total Amount of Subordinated Securitization Retained by the Bank/Total Bank Assets Sold and Securitized, Lines of Credit on Securitized Loans/Total Bank Assets Sold and Securitized). Data on Credit Enhancements are reported in the FDIC Call Reports.

[16] We measure the riskiness of our sample banks' securitized loans by taking the default rate of the banks' securitized loans. We calculate the default rate as the ratio of the Amount of Securitized Loans in Default to the Total Amount of Securitized Loans (i.e. Total Amount of Securitized Loans in Default/Total Bank Assets Sold and Securitized). Data on Securitized Loans in Default are reported in the FDIC Call Reports.

[17] The said instrumental variables have no direct effect on the observed loan portfolio size, but may only be related to it through Securitization Activity. A bank that has had a large Securitization Activity for the previous period may be able to securitize more in the following periods, as its previous securitization activity could allow it to build a certain expertise and reputation in carrying out the transaction (Albertazzi, Eramo, Gambacorta & Salleo (2011)). Likewise, a bank that offers much Credit Enhancements on its securitization transactions may also be able to securitize more, because the Credit Enhancements serve as guarantees that the securitization transactions involve good quality underlying assets and that it will pay-off its investors, even if a default in the underlying assets happen (Thomas (1999), Gorton & Souleles (2005), Ashcraft & Schuermann (2007)) . Meanwhile, a bank with risky securitized loans may find its securitization activity limited, as its high incidence of defaulting securitized loans may signal that the underlying assets on its securitization transactions are of poor quality.

[18] This period may be observed in Figure 1 as the horizon where there has been a steep drop in the securitization of Real Estate Loans (as well as Consumer Loans) and that there has been no recovery since then on in the securitization of loans (irrespective of class).

[19] Consumer Loans and Core Deposits are retail banking activities in the sense that banks transact such activities with individual clients. In a period when there is a high demand for cash among consumers, a surge in applications for Consumer Loans might happen alongside deposit withdrawals, creating a cash flow problem. Thus banks, may want to avoid engaging in both retail lending and borrowing activities simultaneously, or in other words, create a mismatch in their assets and liabilities.

[20] We note that we can see in Figure 2 that the default rates of Real Estate Loans may have caught up with that of Consumer Loans in 2008:2. However, we must consider that this period may have been triggered by an exogenous shock, namely the bursting of the US Housing Market Bubble. Following the US Housing Market Collapse, we can see in Figure 2 that Consumer Loans still have relatively higher default rates than Real Estate Loans.

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[21] Non-Performing Loans are defined as loans that have been past due for 90s days, plus loans that have been in non-accrual status.

[22] In calculating SD NPLs, we use NPLs of the four quarters of each year. As a result we experience a reduction in the number of observations when using this as indicator for loan portfolio risk. The same case applies to SD Charge-Offs.

[23] Loan charge-offs are defined as loans that have been delinquent for at least 120 days.

[24] See Note 22.

[25] As the risk-reward principle posits

[26] Like in the case of SD NPLs and SD Charge-Offs, the SD ROA and the SD ROE are calculated using the ROA and the ROE of the four quarters of each year. As a result we experience a reduction in the number of observations for these particular estimations.

[27] See the Appendix for a discussion on the computation of the Herfindahl-Hirschman Index.

[28] For purposes of brevity, we report in Table 7 only the coefficients of our variables of interest namely *Securitization* and the one-period lag of the diversification index ($1\text{-}HHI_{t-1}$).

[29] The loan portfolio diversification indicator for this set of estimations takes a one-period lag, since we use beginning of quarter values for our independent variables, as in the earlier estimations.

[30] This is because the calculation of the diversification index is based on the portfolio share of each loans class in the bank's loan portfolio.

[31] See Note 28.

[32] As what theory may expect and earlier empirical evidence (such those mentioned in the introduction) may have shown

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Appendix: The Herfindahl-Hirschman Index (HHI)

The HHI is originally a measure of market dispersion (or concentration), calculated using the market shares of a set competing firms. However, the concept of the HHI has been also applied to create an indicator for loan portfolio diversification. Studies that have used the HHI as an indicator for loan portfolio diversification include Acharya, et. al. (2002), and Kamp, Pfingsten, Memmel & Behr (2007). The HHI (as a loan portfolio diversification measure) is calculated as:

$$HHI_B = \sum_{i=1}^{n} q_i^2 \tag{1A}$$

where: HHI_B is the HHI or loan portfolio diversification indicator of bank B, i denotes a particular loan segment in bank B's portfolio, n is the number of segments in bank B's loan portfolio, and $q_i = \dfrac{Q_i}{\sum_{i=1}^{n} Q_i}$ or the share of a certain loan segment *i*, in bank B's loan portfolio.

In our study, we have five loan segments, which are the five loans classes we consider, namely Real Estate Loans, C&I Loans, Consumer Loans, Farm Loans and Other Loans. The HHI takes a value between $1/n$ and 1, where a value equal to 1 means that the bank's loans are of only one segment or that there is full concentration (i.e. no diversification). On the other hand, an HHI equal to $1/n$, implies equal shares among the different loan segments in bank B's portfolio or full diversification. For our analysis, it is more convenient to take and use the inverse of the HHI that is, $1 - HHI$. In this way, we have that a higher (lower) $1 - HHI$ indicates a more diverse (concentrated) loan portfolio for the bank.