MPRA
Munich Personal RePEc Archive

Securitization and Bank Intermediation Function

Zagonov, Maxim

Toulouse Business School, Université de Toulouse

September 2011

Online at https://mpra.ub.uni-muenchen.de/34961/
MPRA Paper No. 34961, posted 23 Nov 2011 13:37 UTC

Securitisation
and
Bank Intermediation Function *

Maxim Zagonov†

September 2011

Abstract

The move from the originate-to-hold to originate-to-distribute model of lending profoundly transformed the functioning of credit markets and weakened the natural asset transformation function performed by financial intermediaries for centuries. This shift also compromised the role of banks in channeling monetary policy initiatives, and undermined the importance of traditional asset-liability practices of interest rate risk management. The question is, therefore, whether securitisation is conducive to the optimal hedging of bank interest rate risk. The empirical results reported in this work suggest that banks resorting to securitisation do not, on average, achieve an unambiguous reduction in their exposure to the term structure fluctuations. Against this background, banks with very high involvement in the originate-to-distribute market enjoy lower interest rate risk. This however by no means implies superior risk management practices in these institutions but is merely a result of disintermediation.

JEL classification: G21; G28; E52; C23
Keywords: Financial institutions; Interest rate risk; Securitisation

*The author would like to thank Hippokrates A. Hadjiilias, Aneel Keswani, Ian W. Marsh, David Stolin, Elyas Elyasiani, Santiago Carbó Valverde and Ning Gong for their valuable suggestions that helped to greatly improve this work. Further, the author is greatful to the seminar participants at the annual meetings of the Australasian Banking and Finance 2010, Midwest Finance Association 2011, Southwestern Finance Association 2011 and Financial Management Association 2011. The findings and conclusions expressed in the paper are entirely those of the author.

†Toulouse Business School, Université de Toulouse, 20 Boulevard Lascrosses, 31068 Toulouse, France. Email: m.zagonov@esc-toulouse.fr; Tel: +33 561 294 974; Fax: +33 561 294 994.

1 Introduction

The recent financial crisis prompted by the US subprime mortgage meltdown has demonstrated the detrimental impact a troubled banking sector has on the wider economy both domestically and internationally. The financial markets worldwide suffered disastrous losses, with massive declines in portfolio values of various, including highly rated, securities. The crisis also led to a severe liquidity shortfall that adversely affected all economic agents. As credit tightened, the myriad of formally prosperous businesses were forced to file for bankruptcy, resulting in soaring unemployment and unprecedented decline in international trade.

Securitisation is generally regarded as the key culprit in the subprime debacle, thus provoking copious discussions on possible remedies for the market for securitised assets. Recently, a plethora of contributions addressed these issues both empirically and analytically[1]. Together these works suggest that the root causes of the crisis are by no means exogenous, and reside in managers' opportunistic behaviour, propensity to short-termism, and concomitant regulatory policies that abetted these trends. Beyond this point of agreement, the issue remains an ongoing debate among academics, practitioners, and policymakers with many of the underlying causes yet to be fully understood.

Interestingly, none of the aforementioned causes is new, and they have all been acknowledged as the primary determinants of the major financial crises in the past. Three common causes are particularly emphasised: moral hazard and information asymmetries; global imbalances; and a poorly designed multi-layered regulatory framework which further aggravated an already present misalignment of incentives.

However, what makes the current crisis different is a contagion which was manifested due to highly developed inter-linkages between international financial corporations, their complexity, multi-sector involvement, and a speedy transmission of news and investment flows. What started as a relatively isolated US subprime mortgage episode was then propagated to the rest of the financial sector worldwide, affecting all major asset classes. In response, a great deal of research has focused on examining the market mechanism by which the financial contagion is proliferated, proposing even more solutions to contain the shock spill-overs in the future (Brunnermeier, 2009; Longstaff, 2010).

Further contributions have also addressed the role of rating agencies, condemning their inability to properly rate the securitised products (Skreta and Veldkamp, 2009). Agencies' incentives, and conflict of interest are also emphasised (Bolton,

[1]A detailed discussion on the mechanisms of the subprime mortgage crisis is offered by Brunnermeier (2009).

Freixas, and Shapiro, 2011). The design of the compensation structure, with managers' rewards being tied to short-term mark-to-market profits rather than the long-term profitability and solvency of created positions, has also been acknowledged for contributing to the crisis (Erkens, Hung, and Matos, 2009). In a similar vein, the regulatory architecture which allowed, and in some instances abetted, such short-termist behaviour has also been denounced (Acharya and Richardson, 2009).

While much has been learnt from these contributions, they have predominantly concentrated on the underlying causes of the current events, not the risks facing the financial system in the aftermath of the crisis. For instance, none has explicitly addressed the issue of bank interest rate exposure, the importance of which was reasserted by recent developments in the monetary environment.

Following an unprecedented reduction in the nominal interest rates, today the concern exists that banks have relaxed their asset-liability management practices and are less protected than ever against rising interest rates[2]. This concern is reflected in the speech of then Vice Chairman of the Board of Governors of the Federal Reserve System, Donald L. Kohn at the Federal Deposit Insurance Corporation's Symposium on Interest Rate Risk Management in January 2010. In his speech, Dr. Kohn stressed that "... interest rate risk is inherent in the business of banking..." and "... it is especially important now for institutions to have in place sound practices to measure, monitor, and control this risk". He further cautioned that as the economy recovers, it is reasonable to expect a tightening in monetary policy, with associated developments in the entire shape of the term structure being hard to predict. In this respect, the unprecedentedly high issuance of government debt worldwide, coupled with increasing inflationary pressure, may trigger sharp changes in the interest rate environment. As suggested by Dr. Kohn, it is highly unlikely that the interest rate volatilities will "...return to their previous quiescent state", thereby posing further concerns for the stability of the financial sector. The shape of the term structure is also likely to undergo significant changes. As the investors return to higher risk leveraged positions, the yields offered on sovereign instruments will have to be revisited in order to successfully finance the fiscal deficit. Furthermore, due to the crisis-induced liquidity constraints, many institutions were forced to shorten the maturity of their liabilities and are accordingly exposed to greater refinancing risk[3].

[2] Over the last two years, the US yield curve has experienced a considerable steepening, with the interest rate spread widening to a multi-decade level high. This steepening poses a significant challenge to the asset-liability managers, particularly in addressing possible non-parallel shifts in the term structure. The empirical evidence on the adverse impacts of low interest rates on bank risk is provided in Altunbas, Gambacorta, and Marqués-Ibáñez (2010).

[3] Further to this, according to the Office of Thrift Supervision Quarterly Review of Interest Rate Risk, in the first quarters of 2010 the median percentage ratio of fixed-rate mortgage loans held by

And while the prudently managed companies will presumably access the required funds, the increased competition for credit may escalate its cost. On the asset side, as many households find the value of their debt exceeding the value of the underlying equity, the rate of defaults is likely to peak with interest rates.

Such economic conditions raise the fundamental question of what are the most effective and suitable ways to hedge against unanticipated developments in the yield curve. In this respect, the theoretical benefits of securitisation for efficient management of bank interest rate risk are unambiguous. On the one hand, securitisation serves as a channel to transfer interest rate risk from the financial intermediary to parties better equipped to bear and manage this exposure. On the other hand, it provides an opportunity to align the duration of interest rate sensitive assets and liabilities, thereby reducing the balance sheet duration gap and concomitant exposure to interest rate movements. Further, securitisation income offers the potential to improve revenue diversification, thus reducing bank reliance on interest-generating activities[4]. Despite these sound theoretical grounds, no empirical account of the impact of securitisation on bank interest rate risk has hitherto been conducted.

Accordingly, the objective of the work reported here is to circumvent the aforementioned issues in addressing the impact of securitisation on bank interest rate risk. In particular, the paper offers three major contributions to the literature.

First, utilising an extensive sample of publically traded US bank holding companies, this work empirically verifies the importance of interest rate exposure for the majority of analysed institutions over the 2001 to 2009 period. Nearly 95 percent of analysed financial intermediaries are adversely affected by yield curve shocks at one time or another, with the yield curve slope being the most significant source of risk. The banks resorting to asset securitisation are affected to a higher degree by term-structure movements than their non-securitising counterparts.

Second, this is the first study which explicitly relates the level of bank securitisation activities to its interest rate exposure. While the empirical evidence to date suggests that securitisation affects the level of bank credit risk, its solvency, and efficiency, no empirical test to assert its impact on bank interest rate risk has been conducted. The results reported here offer a valuable insight to both managers and

the US thrifts to their total assets was at the level of 40.6%, while the corresponding proportion of all adjustable-rate mortgage loans to total assets was at only 22.3%. The effective duration gap in the thrift industry also remained positive, highlighting the firms' susceptibility to rising interest rates.

[4] As argued by Keswani, Marsh, and Zagonov (2011), since activities that generate non-interest income are imperfectly correlated with those generating interest revenues, with raising interest rates, the diversification of revenue sources should help stabilizing operating income and give rise to a more stable stream of profits. This view is supported by the empirical findings of Smith et al. (2003) and Chiorazzo, Milani and Salvini (2008).

regulators looking into securitisation to curb bank interest rate risk. This is particularly important in the aftermath of the global financial crisis, with the monetary policy decisions creating a unique environment for interest rate exposure.

Third, the current research also studies whether the securitisation of assets with different maturities and risk characteristics impacts differently on bank interest rate exposure. The empirical tests suggest that interest rate risk generally increases with the maturity of assets securitised. To decouple the effect of securitisation from other factors, I consider further channels that may have affected bank risk. These include numerous bank-specific characteristics and the macroeconomic environment in which banks operate. Further, the research covers both pre-crisis and crisis episodes, thereby offering an opportunity to compare the effectiveness of securitisation in curbing bank interest rate risk between the two periods. I find that banks resorting to asset securitisation are subject to greater interest rate exposure in the second, crisis sub-period.

The remainder of the paper is organised as follows: Section 2 provides a brief review of the literature and outlines a set of testable hypotheses. Section 3 presents a theoretical model of financial intermediary risk-taking behaviour, while Section 4 continues by outlining the supporting empirical framework. The description of the data sample follows in Section 5. Empirical results are discussed in Section 6, while Section 7 concludes the paper.

2 Literature review and hypotheses formulation

Securitisation is a relatively straightforward process of transforming a pool of illiquid assets into marketable securities via cash flow repackaging; yet it has substantially reshaped the credit markets in recent decades. While originally confined to the US residential mortgages, today, securitisation is applied to a wide range of asset classes, including credit card, commercial and industrial, automobile, and home equity loans, among others. Since its inception in the late 1960s, the issuance of securitised assets in the US has been growing steadily to amount to nearly US $2.11 trillion as of the year end 2009[5].

[5] Aggregate of the US mortgage-related (MBS) and asset-backed securities (ABS) issuance, based on the data compiled by the Securities Industry and Financial Markets Association, http://www.sifma.org. The fastest growth was enjoyed by the MBS sector, with a nearly 11.2% (15.8%) compound annual growth rate between 1996 and 2009 (1996 and 2006). The corresponding growth rates for the US ABS issuance are -0.8% and 16.3% respectively. The declining trend in MBS is likely to persist in the foreseeable future, owed to weak house sales, mortgage loan origination, and new housing start-ups following the crisis. The number of house sales in the US has reached its peak of 1.28 million in 2005, and declined since to 0.38 million in 2009. The same is true for new housing start-ups, declining at a compound rate of 28.1% per year between 2005

On the theoretical front, access to the market for securitised products may substantially benefit the originator by (a) allowing to efficiently diversify its credit portfolio; (b) improving asset-liability management; (c) reducing the cost of financial intermediation; and (d) providing an opportunity to profit by specialising in operations in which it enjoys a comparative advantage[6]. As suggested by Loutskina and Strahan (2009), securitisation eases the influence of bank financial conditions and local funding shocks on credit supply. As a result, it increases liquidity and facilitates the reduction of funding and therefore banks' intermediation costs. Further, securitisation provides a means to efficiently transfer the risk from the banks' balance sheet to other economic players better equipped to bear it, thereby removing the impediment to further growth implied by capital and balance sheet constraints.

In terms of bank interest rate risk, securitisation offers an opportunity effectively to tailor the balance sheet duration gap induced by the banks' asset transformation function. Thanks to heterogeneity in the maturity of assets admissible for securitisation, the duration of rate sensitive assets can be perfectly matched to that of corresponding liabilities. Further, by securitising assets with embedded prepayment provisions, the lender, in effect, resells the position held in these options and therefore hedges its exposure to unanticipated increases in interest rate volatility.

Despite the unambiguous theoretical benefits offered by securitisation, the empirical evidence and the state of market predicament to date suggest that financial institutions may have been unable fully to enjoy such advantages. With many firms moving from an "originate-to-hold" to "originate-to-distribute" business model, the agency problems become ever more apparent and a vast literature analyses this issue in depth (Berndt and Gupta, 2009; Drucker and Puri, 2009). In particular, due to the separation of asset ownership and control functions, the loan originator lacks the incentive to exert enough effort in monitoring the credit quality of any pursued projects. Provided with a channel to alleviate its credit exposure, the intermediary is more concerned with the fees it extracts from the new loan origination rather than the underlying quality of these loans. As demonstrated by Keys et al. (2010), the likelihood of originating sub-quality loans increases with the probability of the loans being sold. Furthermore, the funds released from asset shifts are commonly used to finance more profitable, yet riskier avenues (Cebenoyan and Strahan, 2004; Purnanandam, 2011). And while various mechanisms were introduced to minimise moral hazard and to better align the interests of bankers and investors (Gorton and Pennacchi, 1995), inefficient contractual environment and misplaced regulatory

and 2009 (source: US Census Bureau, http://www.census.gov).

[6] For more insightful discussion on the benefits of securitisation, see Greenbaum and Thakor (1987).

efforts precluded a complete resolution of these problems.

Besides, under poorly designed regulatory capital charges, banks have an incentive to securitise safer, low-yield assets while retaining riskier and more profitable ones. As demonstrated by Ambrose, Lacour-Little and Sanders (2005), intermediaries commonly securitise safer mortgages and retain the more risky ones on the balance sheet. An extensive scope of works provides further empirical evidence to support this "regulatory arbitrage hypothesis" for asset securitisation. Many also agree that even with no capital distortion, the banks are likely to shift safer assets, owed to excessive costs involved in distribution of riskier instruments due to the "lemons" problem (Akerlof, 1970). Additionally, despite the fact that under the FASB140 rule (Financial Accounting Standards Board) securitisation is classified as an asset sale, in practice, this transaction resembles a typical financing arrangement with securitisers commonly retaining their credit exposure by providing various credit enhancements and guarantees. For this reason, the off-balance sheet treatment of such transactions has been greatly criticised in the literature.

Moreover, with the increased popularity of securitised products, a myriad of non-depository market players entered the lending business directly to compete with traditional intermediaries. This translated into increased market competition, forcing many financial institutions to accept higher risks to remain competitive. From this perspective, securitisation is unlikely to be utilised as a risk-transfer mechanism, but is rather motivated by the desire for greater profitability.

On the basis of the discussion so far, and following the recent events in global financial markets, the possibility of banks utilising securitisation to curb interest rate risk seems rather elusive. This view is reflected in the first testable hypothesis:

Hypothesis$_1$: *Banks resorting to asset securitisation face greater interest rate exposure. The extent of this exposure varies with the duration of assets securitised.*

Against this background, there is evidence to suggest that in the run up to the subprime crisis banks successfully shifted a great deal of riskier assets owing to favourable monetary and regulatory conditions. This trend was majorly fuelled by a low interest rate environment, the increased market demand for securitised products, and investors' excessive reliance on credit ratings reinforced by copious regulatory provisions. This view is empirically supported by Mian and Sufi (2009) and Dell'Ariccia, Igan, and Laeven (2008). However, both papers report a pronounced decline in the lending standards associated with higher securitisation rates. The former contribution also reports a significant upturn in bank "disintermediation" over the 2001-2005 period, with a substantial increase in loans sold shortly after origination.

In the same vein, many have argued that in the last decade banks have moved from a traditional spread generating strategy to a new equity-maximisation fees-generating strategy. By assertively strengthening its involvement in the "originate-to-distribute" market, many intermediaries, in effect, function as brokers who extract the fees for joining borrowers and lenders. And while the asset repackaging and sale is costly to the originator, the costs associated with joining the complementary transactions between borrowers and securitised-debt investors are considerably reduced through the standardisation of securitised products. Besides, the company achieves economies of scale by specialising in structured finance transactions. It also enjoys increasing returns to scale in evaluating the borrowers' credit quality due to lax monitoring. Furthermore, the active players in the securitisation market enjoy better access to derivative instruments which, as demonstrated by Purnanandam (2007), enable these companies to preserve the extent of loan origination even as monetary conditions tighten.

With this business model, the importance of interest generating revenues declines, and so does the effective duration of assets held on the balance sheet. Accordingly, the duration gap remains at minimal levels, and the intermediary is less exposed to the risk of changing interest rates. On the basis of this argument, the following hypothesis is added into the analysis:

Hypothesis$_2$: *The relationship between bank interest rate risk and asset securitisation is non-linear. The risk initially increases with the value of assets securitised, but declines with bank "disintermediation".*

3 Theoretical background

The interest rate exposure represents a natural risk faced by all financial intermediaries due to the nature of their maturity transformation business model. In particular, this type of risk may arise from three key sources. First, by transforming the short-term savings to long-term investments, banks unavoidably mismatch the duration of the interest sensitive assets and liabilities. The "Duration Theorem" independently proposed by Samuelson (1945) and Hicks (1946) states that if the weighted duration of the asset stream is greater (less) than the weighted duration of the liability stream, the interest rate increase (decrease) will reduce the individual's net worth. With therefore a positive duration gap, measured as the difference between the durations of assets and liabilities, rising interest rates reduce the value of assets more than the value of corresponding liabilities. The earlier attempt to formalise the practical applications of the proposed theory can be traced to the work of Redington (1952) who introduces the so-called "immunisation rule". Under this simplified rule, the agent chooses to always hedge against interest rate shocks by matching the durations of rate sensitive assets and liabilities.

Second, when the rates earned on the underlying assets are not perfectly correlated with the rates paid on the liabilities, the bank's earnings are exposed to interest rate fluctuation. This is referred to as the interest rate margin risk. Following the Federal Reserve's decision to reduce the interest rates to unprecedentedly low levels, the bankers have enjoyed a substantial increase in the interest rate margins. These conditions may substantially change as the monetary policy tightens, with many banks finding it difficult to refinance some of their fixed rate assets with variable rate liabilities. Finally, the third source of interest rate risk arises from optionality embedded in some assets and liabilities (e.g. prepayment options). This asymmetric source of interest rate risk gained its prominence in recent decades.

To theoretically formalise the aforementioned sources of interest rate risk, and to see how securitisation may be used in curtailing these exposures, this section presents the model of bank intermediation and describes its key attributes. For simplicity, the model concentrates on the banks' duration transformation function and discounts any other claim attributes and risks. Formally, I assume that the interests of shareholders and managers are aligned in their combined utility maximisation (**A.1**). Accordingly, the bank pursues the strategy of maximising its after-tax profits. The credit market is perfectly competitive à la Besanko and Thakor (1987), with the credit contracts designed to maximise the expected utility of borrowers.

At each planning date t the manager can choose the amount to be invested in assets and liabilities of different maturities, conditional on her choices in preceding periods. The maturity of available projects is limited by T, which represents the manager's investment horizon. Some divergences from the target asset mix are inevitable in the short-run, though the bank's choice of principal specialisation determines the market condition it faces and its ability to promptly adjust the composition of the asset portfolio. Bank liabilities are subject to similar constraints, with relatively stable, manager controlled federal funds, though volatile deposit base. The latter contracts represent a relatively stable funding source in the presence of a deposit insurance guarantee. Assuming further that t is continuously defined on the closed interval $[0, T]$, the bank's asset and liability streams over the investment horizon are $A(t)$ and $L(t)$ respectively. The interest rates are stochastic and independent of the banks' choice of balance sheet structure, with the function $R(t)$ characterising the market term structure over the interval $[0, T]$. The intermediary can nonetheless negotiate favourable rate conditions on its assets and liability contracts (e.g., spreads over index rates such as LIBOR) owing to its market power. The BHC's equity value Q is therefore simply the difference between the present values of its asset and liability streams:

$$Q = \int_0^T A(t)e^{-R(t)t}dt - \int_0^T L(t)e^{-R(t)t}dt = A - L \tag{1}$$

where the present values of asset and liability streams are denoted by A and L respectively.

In a similar manner, the BHC's net income $\forall t > 0$ is defined as:

$$I = R^a(t)A(t) - R^l(t)L(t) \tag{2}$$

where $R^a(t)$ and $R^l(t)$ are interest rates charged on assets and liabilities respectively. For convenience, the regulatory capital charges, as well as the operational costs of servicing the asset and liability portfolios are assumed away in this specification.

Accordingly, following Assumption 1 (**A.1**) above, the bank shareholders are concerned with maximising the value of bank profits:

$$\pi(t) = R^a(t)A(t) - R^l(t)L(t) + \triangle Q \tag{3}$$

Note that the equity value Q is unaffected if the yield curve remains unchanged over the period; and the bank profits are driven by the net interest margin.

As, however, the term structure evolves, both the bank interest margin and its equity value would be affected in a number of ways. The exact nature of such response is convoluted due to the direction of rate movements, the occurrence of non-parallel shifts in the term structure, and the relationships between the bank assets and liabilities rates. These considerations unnecessary complicate the model, and a number of simplifying assumptions are introduced as follows:

A.2 The shifts in the interest rate yield curve are parallel in nature: given a continuous random variable q with a probability density function $f(q) \geq 0$ and $a \leq q \leq b$, the future yield curve can be described by $R(t) + q$, $\forall t \in [0, T]$.

Accordingly, assuming $R(t) = R$ in (3), the bank interest income remains unaffected as long as the adjustment speed of the rates charged on assets and the rates paid on liabilities is the same:

$$\frac{\partial R^a(t)}{\partial R} = \frac{\partial R^l(t)}{\partial R} \tag{4}$$

Under this condition, the profits are determined by the term-structure driven changes in the market values of the intermediary's assets (A) and liabilities (L):

$$\frac{\partial \pi}{\partial R} = \frac{\partial Q}{\partial R} = -\int_0^T A(t)e^{-R(t)t}dt \times \frac{\int_0^T tA(t)e^{-R(t)t}dt}{\int_0^T A(t)e^{-R(t)t}dt} + \\ + \int_0^T L(t)e^{-R(t)t}dt \times \frac{\int_0^T tL(t)e^{-R(t)t}dt}{\int_0^T L(t)e^{-R(t)t}dt} \quad (5)$$

It is easy to see that

$$\frac{\int_0^T tA(t)e^{-R(t)t}dt}{\int_0^T A(t)e^{-R(t)t}dt} \text{ and } \frac{\int_0^T tL(t)e^{-R(t)t}dt}{\int_0^T L(t)e^{-R(t)t}dt}$$

are the weighted average time to maturity, or durations, of assets and liability streams respectively. Denoting the duration of assets with MD_A and the duration of liabilities with MD_L, we get:

$$\frac{\partial \pi}{\partial R} = \frac{\partial Q}{\partial R} = L \times MD_L - A \times MD_A \quad (6)$$

It therefore follows that the manager's decision problem is to choose the MD_L and MD_A that maximise the value of bank equity Q. Assuming, however, the stochastic nature of the interest rate movements [$E(q)= \int_a^b qf(q)dq$], adjusting the durations is barely an improvement over the immunisation strategy.

Since banks commonly assume a positive asset-liability duration mismatch, to reduce the sensitivity of a company's value to interest rate fluctuation, the risk manager must either reduce the duration of assets MD_A or increase the duration of liabilities MD_L. In this respect, securitisation offers an elegant solution to the first problem, owed to heterogeneity in the assets admissible for securitisation. In particular, the lender with a positive duration mismatch can use securitisation in at least two ways to curtail its interest rate exposure: (a) it can securitise the long term-assets, such as mortgages, off the balance sheet, thereby reducing the effective duration gap; (b) it can securitise assets with embedded prepayment provisions and thus hedge its exposure to unanticipated increases in interest rate volatility.

4 Methodological framework

4.1 Yield curve modelling

The standard research methodology of assessing the interest rate exposure proposes to use a single interest rate factor (Stone, 1974). Therefore, it fails to recognise the time-varying nature of the yield curve shape.

In this study, I account for the sensitivity of BHCs' stock returns to the changes in the entire shape of the term structure by employing simultaneously the level, slope and curvature of the interest rate yield curve. These measures are calculated via the Diebold and Lee (2006) factorisation of the Nelson and Siegel (1987) model:

$$y_t(\tau) = \beta_{1,t} + \beta_{2,t}\left[\frac{1-e^{-\lambda\tau}}{\lambda\tau}\right] + \beta_{1,t}\left[\frac{1-e^{-\lambda\tau}}{\lambda\tau} - e^{-\lambda\tau}\right] \tag{7}$$

where τ represents the maturity of the underlying fixed-income security and λ is a decay parameter discussed below.

The Nelson-Siegel model uses just a few parameters (compared for example to spline methods) and provides enough flexibility to capture a range of monotonic, S-type and humped shapes typically observed in the yield curve data. It fits the term structure using a flexible, smooth parametric function based on a Laguerre function. Notably, due to its ability to provide a good fit of the interest rate yield curves the model is advocated by Diebold and Lee (2006), and Czaja, Scholz and Wilkens (2010), and is widely used by central banks and practitioners. The central banks in nine out of thirteen countries members of the Basel Committee of Banking Supervision construct a sovereign zero-coupon yield curve using the Nelson-Siegel class of models.

To estimate the yield curve level, slope and curvature, the series of the sovereign zero-coupon yields of 12 different maturities (τ = 3, 6 and 12 months, and 2, 3, ..., 10 years) are sourced from the U.S. Federal Reserve Board statistical releases. These series are used as the initial estimates on the left hand side.

Based on the model parameterisation above, the loading on the level ($\beta_{1,t}$) parameter is 1 and is independent of time-to-maturity. Taking the limit, it is easy to see that $\lim_{\tau\to\infty} y_t(\tau) = \beta_{1,t}$ and hence the yield curve level can be seen as a long-term interest rate variable. It also worth noting that an increase in $\beta_{1,t}$ would identically affect all yields, thereby shifting the level of yield curve. Similarly, the loading on the slope parameter $\beta_{2,t}$ is driven by the exponential function starting at 1 and decreasing monotonically to zero with increasing maturity. Therefore, the slope parameter might be seen as short-term interest rate variable. An increase in this parameter would amplify the short-rates more than the long ones. In mathematical terms, given $\lim_{\tau\to 0} y_t(\tau) = \beta_{1,t} + \beta_{2,t}$, it is easy to see that $y_t(\infty) - y_t(0) = -\beta_{2,t}$. The loading on the last parameter $\beta_{3,t}$ (curvature) is also driven by the exponential function, now starting at zero (with the $\tau = 0$), increasing for the medium maturities and decaying back to zero as maturity increases. Accordingly, the yield curve curvature ($\beta_{3,t}$) can be seen as the medium term interest rate variable.

Following Diebold and Lee (2006), and Czaja, Scholz and Wilkens (2010), to obtain the estimates of the level, slope and curvature, the identified series of zero-coupon yields are regressed on the factor loadings and a constant using the cross-sectional ordinary least squares technique. With this model factorisation the parameters on the right hand side are calculated assuming the prefixed value of decay parameter λ. Consistent with Diebold and Lee, the value of the decay parameter λ is fixed and is chosen to maximise the loading on the curvature parameter. For comparison, the time-varying decay parameter λ is also employed. In this specification λ is chosen to maximise the goodness-of-fit statistics of the underlying model at each time t. Both specifications yield statistically identical results. To avoid introducing an additional time-varying component in the yield-curve model, I resort to the fixed λ specification.

Figure 1 plots the estimated level, slope and curvature factors, with the pertinent statistics outlined in the corresponding table.

Compared to the yield curve slope and curvature, the level factor is less volatile. This observation is not surprising since the yield curve level serves as a proxy for the long-term interest rate, with the yields at the long end of the term structure being generally less volatile.

4.2 Interest rate exposure

To address the underlying empirical hypotheses, I follow a two-stage estimation procedure in line with previous literature in the area. In the first step, the interest rate exposure of BHCs' stock returns is modelled via a four-factor GARCH(n, m) parameterisation[7] of the market model formalised as:

[7] The GARCH based econometric framework is used to account for a time-varying element in the distribution of BHCs' stock returns. See for instance Elyasiani and Mansur (1998), Flannery, Hameed and Harjes (1997).

$$R_{it} = \alpha + X'_{it}\beta + \varepsilon_{it} \quad (8)$$

$$h_{it} = \omega_0 + \sum_{i=1}^{n} \gamma_1 \varepsilon^2_{i,t-1} + \sum_{i=1}^{m} \gamma_2 h_{i,t-1} \quad (9)$$

$$\varepsilon_{it}|\Omega_{t-1} \sim N(0, h_{it}) \quad (10)$$

where R_{it} represent the weekly logarithmic returns[8] on BHC i ($i = 1$ to 304) for the firm's fiscal year t; α is a scalar, β is a $K \times 1$ vector of coefficients and X_{it} is the it-th observation on K explanatory variables: $X\prime = (R_M, R_{Level}, R_{Slope}, R_{Curvature})$. R_M is return on the S&P500 market index. R_{Level}, R_{Slope}, and $R_{Curvature}$ represent unanticipated changes in the level, slope, and curvature of the domestic sovereign zero-coupon yield curve at time t respectively. The use of unanticipated changes is advocated by previous research suggesting that asset values should already incorporate all the anticipated changes in interest rates. I estimate these unanticipated changes as the difference between the actual changes in the respective factor at time t and ones forecasted via the appropriate specification of the ARMA (k, l) model[9]. ε_{it} is the estimated error term from the mean equation of portfolio i, and h_{it} is a conditional variance of portfolio i over week t. The order of lags (n, m) ensures the adequate treatment of serial correlation in squared returns, with the formal Engle ARCH Lagrange multiplier and Ljung-Box Q-statistics determining the correct lag structure.

The estimated coefficients measure the sensitivity of bank i's stock returns to changes in the considered interest rate factor. They are treated as independent variables in the empirical framework to follow.

4.3 Securitization and interest rate risk

In the second step, the estimated measures of interest rate risk are related to proxies of bank securitisation and asset sales activities. I use panel data techniques to fully exploit the potential of the data sample, and to control for unobserved cross-

[8] To avoid the bias introduced by the Monday or Friday market effects (French, 1980; Pettengill, Wingender and Kohli, 2003), the calculation of returns is based on the Wednesday to Wednesday stock prices. The choice of the weekly sampling interval instead of daily or monthly is determined by two reasons. First, the findings of Trzcinka (1986) indicate that the returns calculated at a daily frequency are not well explained by the normal distribution. By using, however, monthly sampling frequency the non-normality of daily observation would be avoided just at the expense of information loss. Second, the use of weekly intervals reduces distortions due to non-trading holidays and noise trading.

[9] For most interest rate factors, the ARMA (k, l) model is specified with autoregressive (k) and moving average (l) parameters ranging from 1 to 3.

sectional and time heterogeneity. The workhorse model specification accounts for both company specific financial characteristics and the overall economic and business conditions in which these firms operate:

$$\left|\beta_{it}^{k}\right| = \varphi + SEC_{i,t-1}'\lambda + Y_{i,t-1}'\psi + G_{t-1}'\xi + T_t' + \eta_i + \varepsilon_{it} \tag{11}$$

where, β_{it}^{k} represents the interest rate risk measure k in year t for bank i. As discussed above, these measures represent the BHCs' equity return sensitivity to unanticipated changes in the yield curve level, slope, and curvature. λ is an $S \times 1$ vector of coefficients and SEC_{it} is the it-th observation on S securitisation proxies. Similarly, ψ is an $M \times 1$ and Y_{it} is the it-th observation on M company specific financial characteristics; while ξ is an $L \times 1$ and G_t is the t-th observation on L macroeconomic characteristics. T_t is a vector of year - dummies of dimension $T-1$, and the company specific effect is measured by η_i. The model is estimated by either treating η_i as fixed (fixed effect model), thus assuming $(N + M + L)$ unknown coefficients, with $\eta = (\eta_1, \ldots, \eta_N)\prime$ being company specific intercepts; or random (random effect model). In the random effect specification $\eta_i \sim IID(0, \sigma_\eta^2)$ and is independent of $\varepsilon_i \sim IID(0, \sigma_\varepsilon^2)$. Further, both η_i and the disturbance term ε_i are independent of (SEC_{it}, Y_{it}, G_t) for all i and t. For both model specifications the robust standard errors adjusted for serial correlation and heteroskedasticity are calculated.

In line with Keswani, Marsh, and Zagonov (2011) and Au Yong, Faff and Chalmers (2009), the absolute values of interest rate betas are used as the dependent variable in the second step regressions. This aids an economic interpretation of the estimated results and can be reconciled with the notion that both positive and negative exposures to yield curve shocks represent the risk to bank economic value and should be treated accordingly. Further, to facilitate the validation of the proposed hypotheses, various parameterisations of the baseline model are introduced through empirical investigation.

5 Sample selection

The dataset spans the 2001 to 2009 period and consists of the US publicly traded bank holding companies (BHC). The choice of sample period is driven by the availability of required data on BHCs' securitisation activities. I identified publicly traded BHCs by cross-referencing the institutions appearing both in the Federal Reserve Bank of Chicago Bank Holding Company database and in the dataset supplied by the University of Chicago's Centre for Research in Security Prices (CRSP). The requisite dataset is accordingly constructed by merging the income statement and balance sheet data from the Consolidated Financial Statement for Bank Holding Companies (FR Y-9C form) with the equity market data from CRSP on the basis of company name and its geographical location. The equity returns are of weekly frequency, all adjusted for dividend reinvestment and stock splits by CRSP. I further check for the dataset consistency with Compustat using the CUSIP identifier.

The focus on BHCs instead of their commercial bank subsidiaries is determined by two factors. First, the share price data is commonly available for only the BHC and not individual banks. Second, the decisions concerning the company's capital and risk management strategies are ordinarily undertaken at the highest level, and are not necessarily directed at a single subsidiary.

The banks with missing data on securitisation and asset sales activities, derivative transactions, total loans and assets, and equity capital are excluded from the sample. The same applies for the acquired entities. Every effort is taken to detect and address any outliers arising as a result of measurement or reporting errors in the underlying datasets. Other non-technical representative outliers, depicting genuine variability in the considered variables, are dealt with accordingly as per the discussion to follow. This yields a total of 304 bank holding companies with the required information being continuously available across the entire sample period. The list of analysed banks is in Appendix A, while the considered variables alongside their detailed definitions can be found in Appendix B. For each BHC, the annual aggregates of the underlying data are used. The average value of total assets for these institutions ranges between \$16,524 million in 2001 and \$35,682 million in 2009, with the median for two years being \$1,017 billion and \$2,023 billion respectively.

Bank attributes related to securitisation and loan sales activities are from Schedule HC-S of FR Y-9C filings. For each BHC, I measure the aggregate value of assets, by category, securitised and sold, or sold but not securitised, within a given fiscal year. Additionally, the value of the outstanding principle balance of assets securitised or sold for each bank-year is also considered. The pertinent statistics on these measures, by year, are reported in Table 1, with a detailed definition for each variable available in Appendix B. Evidently, the loans secured by 1-4 family residential real estate dominate securitisations and loan sales. This is followed by commercial and industrial, and credit cards receivable loans.

[**Insert Table 1 here**]

To account for further bank characteristics and the macroeconomic environment in which these institutions operate, I introduce two sets of control variables accordingly.

5.1 Bank specific control variables

There are six firm level controls, all constructed using FR Y-9C filings. First, given the evidence of significant U-shaped relationships between bank capital and interest rate risk (Keswani, Marsh, and Zagonov, 2011), the ratio of equity capital to BHC's total assets (CAP) is deployed. It should be noted that by facilitating the diminution in regulatory capital requirements, securitisation may render the capital ratios an unreliable approximation of the true bank capital constraints. This, however, should not significantly alter the importance of this factor in explaining the banks' interest rate sensitivity because the equity capital itself represents not-interest rate sensitive liability. Accordingly, firms with higher capital levels are expected to be less sensitive to interest rate shocks.

Second, following the rationale outlined in previous works, the measure of bank liquidity (LATA) is also considered. In line with empirical literature, a positive relationship between banks' liquidity and risk is expected. Care should be taken in interpreting this variable, since securitisation may affect the short-term fund inflows and hence inflate the bank liquidity ratios. Third, the ratio of non-performing loans[10] (NPL) is used to measure the quality of the bank asset portfolio. Fourth, based on the theoretical underpinning outlined in the previous section and in line with Flannery and James (1984), the measure of balance sheet asset-liability mismatch (GAP) is calculated as the difference between interest-earning assets and interest-bearing liabilities maturing or being repriced within one year, scaled by the bank's total assets. As per the outlined theory, a positive sign on this variable is expected. Fifth, since the originator commonly retains an equity-like interest in the transaction, thus maintaining its exposure to credit and prepayment risks, the bank purchase of credit protection (e.g. credit default swaps) can be seen as an attempt to hedge this exposure. To this end, I calculate the bank's net credit protection purchase (NECP) as the difference between the credit protection it buys and sells in a given fiscal year.

Finally, to control for the effect of bank activity diversification, a set of asset and revenue diversification measures is constructed. In line with Laeven and Levine (2007), the diversification of net operating revenue (ROID) is proxied via a modified specification of a Herfindahl-Hirschman Index (HHI) as follows:

$$ROID = 1 - \left| \frac{\text{Interest income - Non-interest income}}{\text{Total operating income}} \right| \tag{12}$$

[10] A loan is considered delinquent if it fails to acquire interest, or when a payment is 90 days or more overdue but interest is still acquired.

This measure assumes values between 0 and 1, with a higher value suggesting greater degree of income diversification.

In addition, the income concentration in both interest and non-interest revenue streams is also captured via a Herfindahl-Hirschman Index. In particular, I consider a broad eight part breakdown for non-interest revenues (H_NOIR), and a twelve part breakdown for the interest income (H_NITR). In a similar manner, the loan concentration HHI (H_LOAN) is computed considering five major categories of loans. These include agricultural, commercial and industrial, consumer, real estate, and other loans. More information on the construction of all variables is given in Appendix B.

To improve the fit of the empirical model, I control for further bank characteristics that may explain the variation in the risk exposures. Namely, the return on assets (ROA) is utilised to proxy the bank operational performance and efficiency, while the return on equity (ROE) is discounted in the analysis due to its deceptiveness for firms with highly leveraged balance sheet. It may also be argued that the level of bank securitisation, as well as its risk exposure, is determined by the growth rate of its assets base. Accordingly, the asset growth rate (AGR) is added to account for this supposition. Finally, as securitisation alters the value of banks' on-balance sheet assets, the size indicator becomes less relevant (DeYoung and Rice, 2004) and it is omitted from the analysis.

To this end, Panel A of Table 2 provides key comparative statistics for the outlined measures between securitisers and non-securitisers, while Table 3 presents pairwise correlations for these variables.

[Insert Tables 2 and 3 here]

BHCs resorting to asset securitisation are larger, retain higher capital buffers, and have better diversified non-interest revenues, while their non-securitising counterparts excel in diversifying the interest income. Generally, securitisers seem to better balance the shares of interest and fee-generating revenues in their total operating income (ROID). Securitisers also maintain a better diversified loan portfolio, which, however, seems to be of a lower credit quality as suggested by loan-loss provision and non-performing loan ratios. Further, these firms purchase more credit protection than their non-securitising peers. This provides evidence to support the "regulatory arbitrage hypothesis" for asset securitisation discussed above. Finally, BHCs not involved in the originate-to-distribute market maintain a lower asset-liability mismatch on the balance sheet, suggesting that these firms resort to stricter asset-liability management practices.

5.2 Economic environment

In the second group of controls, the overall economic and business conditions are captured by the annual growth rate in the gross domestic product (GDPG), and the Aruoba-Diebold-Scotti Business Conditions Index (ADSI) sourced from the Federal Reserve Bank of Philadelphia database (Aruoba, Diebold, and Scotti, 2009), respectively. The latter measure accounts for the real economic activity at high frequency, on the basis of both high- and low-frequency information on six major economic indicators (i.e. weekly initial jobless claims, monthly payroll employment, industrial production, personal income less transfer payments, manufacturing and trade sales, and quarterly real GDP). This index has an average value of zero, with progressively greater values indicating better than average business conditions and vice versa. The descriptive statistics for both figures are outlined in Table 2: Panel B.

To get more stable estimates in the empirical model, all considered explanatory variables ($\psi = Y, G$) are treated for outliers via type I winsorization[11], with fixed cut-off points of $\overline{\psi} \pm 4\hat{\sigma}$. Alternatively, the variables are winsorised at the 1 and 99 percentiles, with the results being robust to the variable winsorisation..

6 Empirical Results

The discussion begins with the results obtained in the first stage estimation in Section 6.1. The multivariate regression analysis is discussed in section 6.2.

6.1 Bank interest rate sensitivities

The interest rate exposure of the analysed BHCs is assessed via a four-factor $GARCH\ (n, m)$ model formalised in Eq. (8). This model is estimated for each bank-year, with Table 4 presenting comparative statistics of estimated interest rate factors for securitisers and their non-securitising peers.

[Insert Table 4 here]

At least 10% of the examined BHCs are significantly affected by the adverse movements in different components of the interest rate yield curve, thereby indicating the inability of risk managers to timely adopt adequate hedging strategies. Notably, while the effect of interest rate shocks on the values of both securitisers

[11] Type 1 winsorisation commonly refers to the procedure of replacing outliers with the exact value of the interval limit, while with Type 2 outliers are transformed to predestined weighted average between their original and the cut-off values.

and non-securitisers is similar in its magnitude, the proportion of securitisers significantly affected by these shocks is appreciably higher. This, in a way, supports the first empirical hypothesis which argues that securitisation is unlikely to be employed as a risk-transfer mechanism.

The majority of the significant interest rate factors are negative, suggesting that BHCs maintain a positive duration mismatch between their interest sensitive assets and liabilities.

6.2 Securitization and interest rate risk

For the main research hypotheses, the panel model in Eq. (11) is first estimated with time- and state-fixed effects applied to the entire sample of BHCs. The sensitivities of equity values to unanticipated changes in the yield curve level, slope, and curvature estimated from Eq. (8) are interchangeably used as the endogenous variable in this model. The explanatory variables that control for the company financial characteristics, and the country economic conditions, are as discussed in previous section. All right-hand side measures are lagged to avoid simultaneity bias. When the economic environment proxies are added into the model, the time-fixed effect is relaxed.

Considering first the intermediaries' exposure to changes in the long end of the yield curve, Table 5: Panel A outlines the empirical results for Hypothesis 1. The proxy for bank securitisation activities (TSEC) enters the table positively and significantly at the one percent level. This implies that BHCs with a greater outstanding value of securitised assets tend to increase interest rate exposure, with this evidence providing additional support for the proposed hypothesis. This is also consistent with the view that securitisation is unlikely to serve as a risk-transfer mechanism, and is instead motivated by the desire for greater profitability.

[Insert Table 5 here]

To attest the second part of the hypothesis, concerning the duration of assets securitised, I aggregate securitisations by the maturity of the underlying assets into three categories: long-term (1-4 family residential mortgages), medium term (home equity lines of credit and commercial and industrial loans), and short-term (auto loans, credit card receivables, and other consumer and commercial loan and leases). Given that commercial and industrial loans commonly include short- and medium-term lending to businesses, they enter both short- and medium-term categories interchangeably. The results, also reported in Table 5: Panel A, are robust to either specification.

It appears that increases in interest rate exposure are mainly driven by securitisation of long-term assets, which are mainly represented by residential mortgages. This is not surprising given that these type of loans dominate securitisations and asset sales, and the funds released from these transactions are likely to be reutilised to extend the loans of similar long-term maturity, yet lower quality. This is in line with the "regulatory arbitrage hypothesis", which suggests that banks commonly securitise safer, low-yield, assets and retain more profitable, though riskier, ones on the balance sheet. This also is consistent with the empirical findings of Ambrose, Lacour-Little and Sanders (2005), and is further supported by the observation of higher proportion of non-performing loans and the asset-liability maturity gap measure for securitising firms. Besides, the distribution of riskier, opaque, assets would incur a heavy discount due to the "lemons" problem suggested by Akerlof (1970), and would introduce an impediment to the bank's external funding channel once the market participants learn about the underlying quality of securitised products.

Accordingly, the retained mortgages are subjected to greater interest rate risk, with their credit quality likely to further deteriorate as the interest rate shocks are passed on to customers (Drehmann, Sorensen and Stringa, 2010).

Against this background, it can be argued that banks with high involvement in the originate-to-distribute market function more as brokers, who generate fees by matching the complementary transactions between borrowers and securitised-debt investors, than financial intermediaries. Under this "disintermediation" business model, the bank shifts the majority of originated loans, and, therefore, has a comparative advantage in selecting the projects most suitable for securitisation. Further, given that loans exit the balance sheet soon after origination, the effective duration of assets and liabilities held on the balance sheet is short-term and can be closely matched. Given this background, the active players in securitisation markets are expected to be less exposed to the risk of changing interest rates, with this view being reflected in the second research hypothesis.

To test this supposition empirically, I reformulate the model in Eq. (11) in a non-linear form as follows:

$$\left|\beta_{it}^{k}\right| = \varphi + \lambda_1 TSEC_{i,t-1} + \lambda_2 TSEC_{i,t-1}^2 + Y_{i,t-1}'\gamma + G_{t-1}'\xi + T_t'\theta + \eta_i + \varepsilon_{it} \quad (13)$$

where, β_{it}^{k} represents the stock return sensitivity of bank i to unanticipated changes in the yield curve level, slope, and curvature at year t. $TSEC_{it}$ is the it-th observation on the company securitisation proxy, and Y_{it} is the it-th observation on M company specific financial characteristics. T_t and η_i are vectors of year- and state-dummies respectively.

Given the model parameterisation, I predict a negative sign on the coefficient estimate for the squared securitisation proxy ($TSEC^2$), and a positive sign on $TSEC$ variable: $\lambda_1 > 0$ and $\lambda_2 < 0$.

[Insert Table 6 here]

The estimation results in Table 6 support the hypothesised relationship, implying that interest rate risk initially increases with the value of assets securitised, but declines with bank "disintermediation". Once again, the results are driven by the securitisation of long-term assets, with non-linearity being only confirmed for the long-term interest rates represented by the yield curve level.

In a similar manner, the remaining interest rate factors (yield curve slope and curvature) are evaluated in Table 5: Panels B and C. For all three measures of interest rate risk the results are consistent with the theoretical prediction that banks do not necessarily resort to securitisation to curb their risk exposure. As discussed above the parameter estimate for the securitisation proxy (TSEC) enters all Tables significantly positive. In this respect, the magnitudes of ∂IRR/∂TSEC suggest a great economic significance. Thus, a one percent increase in the proportion of total assets securitised translates into about 0.053 percent increase in BHCs' exposure to shocks in the yield curve level. This, in turn, would imply that a typical US securitiser will incur an additional \$1.79 million decline in its market value following a typical shock in the yield curve level. The corresponding values for interest rate slope and curvature are \$4.01 million and \$1.17 million respectively.

Turning to the remaining bank characteristics in Eq. (11), the majority of coefficients estimates are statistically significant and bear the expected sign. Consistent with prior empirical research, the relationship between equity capital and bank risk taking is U-shaped. That is, both undercapitalised and well capitalised intermediaries are generally riskier than banks with intermediate, optimal capital levels. Further, the institutions with higher degree of revenue heterogeneity also enjoy lower risk exposures, and so are the companies with higher asset base growth rate. Not surprisingly, the coefficient on the ratio of non-performing loans enters the table negative, owed to the intrinsic link between credit and interest rate risks (Drehmann, Sorensen and Stringa, 2010).

6.3 Robustness checks

To corroborate the findings from the basic model in Eq. (11), I perform a comprehensive set of robustness checks. These include the use of different time horizons and subsamples; the assumption of alternative model specification and distributional properties; and an extensive treatment of endogeneity and simultaneity biases.

In the context of this study, endogeneity may arise when the BHC's decision to participate in the market for securitised products does not only influence, but is influenced by its interest rate exposure. In this scenario, the exogenous treatment of securitisation activities would introduce simultaneity bias in the regression estimates. Furthermore, additional factors may jointly influence the variability in both measures, biasing the ordinary least squares estimation and making it difficult to infer causal relationship. To address these concerns, I detect potential endogeneity via a Hausman test and resort to a two-stage least squares (2SLS) panel estimation procedure by introducing a set of instruments for the BHCs' securitisation activities as appropriate. To identify suitable instruments, I address the bank's decision to securitise by analysing its financial characteristics in the probit framework (not reported). The results remain robust to the choice of estimation technique. Column 1 of Table 7 details the empirical output for the 2SLS regression assuming the BHCs' exposure to the shocks in the yield curve level as an endogenous variable. Although not reported, the results for the remaining interest rate proxies also remain statistically unchanged.

[**Insert Table 7 here**]

Furthermore, caution should also be taken in isolating the risk management motives of asset securitisation from auxiliary inducements. In particular, the incentive to securitise may be circumscribed by the level of loan demand and current economic conditions. Faced with unusually high demand for loans, banks would resort to asset sales to extract higher loan origination rents, and to satisfy the existing customer demand for funds. On the other hand, weaker loan demand conditions following the economic downturn make it difficult for an intermediary to successfully perform the securitisation transaction. This is due to low liquidity and demand for ABS, and higher credit risk of the underlying asset mix resulting in market mispricing. Such economic conditions would also affect the level of bank interest rate exposure.

In this respect, the analysed sample period provides a unique opportunity to explicitly test this supposition by separating the time horizon into pre-crisis and crisis episodes. This also provides a comparison of the effectiveness of securitisation in curbing interest rate risk between the two periods. In addition, the sample of companies is separated into a number of sub-samples on the basis of ranking by the bank's (1) size, (2) liquidity, and (3) net derivative usage (hedging - trading). Selected are the top 25% and the bottom 75% of values in each category, with a total of six portfolios constructed.

The pertinent results for these tests are also reported in Table 7. The coefficient estimates on the bank securitisation proxy remain robust to the considered time horizon, thus reconfirming the findings in the previous section. Not surprisingly, it appears that BHCs are subjected to greater risk exposure in the second crisis-episode. Turning to the measure of bank size, the estimate on the securitisation proxy remains significant only for the smaller companies. This might be explained by the fact that larger BHCs are better equipped to weather the yield curve shocks owed to better diversified portfolios and unrestricted access to the markets for derivative products. On the other hand, these firms might also pursue the "disintermediation" business model, therefore reducing the balance sheet duration gap and concomitant exposure to interest rate movements. Once the bank liquidity and derivative activities are considered the estimation suggests that the risk exposure is greater for the companies retaining higher liquidity buffers and for BHCs which are the net traders of derivative instruments. The intermediary is classified as the net-trader if the notional amount of all derivative instruments held for trading exceeds that of instruments held for hedging.

7 Concluding remarks

The recent turmoil in global financial markets, prompted by the US subprime mortgage meltdown, has once again accentuated the importance of banking sector prudency for overall economic stability worldwide. Securitisation is consensually regarded as the key culprit in the subprime debacle, with a plethora of works addressing possible remedies for the market for securitised assets. These contributions, however, are largely concerned with the underlying causes of the current events, not the risks facing the financial system in the aftermath of the crisis. None has explicitly addressed the issue of bank interest rate risk, the importance of which becomes increasingly apparent in the current monetary environment. This concern has been recently flagged by regulatory authorities both in the US and in Europe, with supervisors emphasising the necessity of establishing robust practices to measure, monitor, and control bank interest rate exposures.

In this context, the move from the originate-to-hold to originate-to-distribute model of lending profoundly transformed the natural asset intermediation function performed by banks for centuries and compromised the importance of traditional asset-liability practices of interest rate risk management. Against this background, this work empirically examines the impact of securitisation on bank interest rate risk. In particular, the research questions whether securitisation is conducive to the optimal hedging of bank interest rate risk, or is merely a funding source enabling these companies to pursue more profitable, yet riskier, projects

The empirical results reported in this work suggest that banks resorting to asset securitisation do not, on average, achieve an unambiguous reduction in their exposure to the term structure developments. It appears that interest rate risk generally increases with the maturity of assets securitised, with securitisation of long-term assets driving the results.

In addition, banks with very high involvement in the originate-to-distribute market enjoy lower interest rate risk, thereby suggesting an asymmetric U-shape relationship between bank risk and securitisation. This observation, however, does not imply superior risk management practices in these institutions but is merely a result of disintermediation. In particular, I argue that BHCs with high involvement to the market for securitised products function more as brokers, who generate fees by matching the complementary transactions between borrowers and securitised-debt investors, than financial intermediaries. Under this "disintermediation" business model, the importance of interest generating revenues declines, and so is the effective duration of assets held on the balance sheet. Accordingly, the duration gap remains at minimal levels, and the intermediary is better protected against term structure developments.

References

[1] Acharya,V.V., Richardson, M., 2009. Restoring financial stability: How to repair a failed system. Wiley.

[2] Akerlof, G.A., 1970. The market for "lemons": Quality uncertainty and the market mechanism. Quarterly Journal of Economics 84, 488-500.

[3] Altunbas, Y., Gambacorta, L., Marqués-Ibáñez, D., 2010. Does monetary policy affect bank risk-taking? European Central Bank, Working paper series No 1166.

[4] Ambrose, B. W., Lacour-Little, M., Sanders, A.B., 2005. Does regulatory capital arbitrage, reputation, or asymmetric information drive securitization? Journal of Financial Services Research 28, 113-133.

[5] Aruoba, S.B., Diebold, F.X., Scotti, C., 2009. Real-time measurement of business conditions. Journal of Business and Economic Statistics 27, 417-427.

[6] Au Yong, H.H., Faff, R., Chalmers, K., 2009. Derivative activities and Asia-Pacific banks' interest rate and exchange rate exposures. Journal of International Financial Markets, Institutions and Money 19, 16-32.

[7] Berndt, A., Gupta, A., 2009. Moral hazard and adverse selection in the originate-to-distribute model of bank credit. Journal of Monetary Economics 56, 725-743.

[8] Besanko, D., Thakor, A.V., 1987. Competitive equilibrium in the credit market under asymmetric information. Journal of Economic Theory 42, 167-182.

[9] Bolton, P. Freixas, X., Shapiro, J., 2011. The credit ratings game. Journal of Finance, forthcoming.

[10] Brunnermeier, M.K., 2009. Deciphering the liquidity and credit crunch 2007-2008. Journal of Economic Perspectives 23, 77–100.

[11] Cebenoyan, S.A., Strahan, P.E., 2004. Risk management, capital structure and lending at banks. Journal of Banking and Finance 28, 19-43.

[12] Chiorazzo, V., Milani, C., Salvini, F., 2008. Income diversification and bank performance: Evidence from Italian banks. Journal of Financial Services Research 33, 181-203.

[13] Czaja, M., Scholz, H., Wilkens, M., 2010. Interest rate risk rewards in stock returns of financial corporations: evidence from Germany. European Financial Management 16, 124-154.

[14] Dell'Ariccia, G., Igan, D., Laeven, L.A., 2008. Credit booms and lending standards: Evidence from the subprime mortgage market. IMF Working paper series No. WP/08/106.

[15] DeYoung, R., Rice, T., 2004. How do banks make money? The fallacies of fee income. Economic Perspectives, Federal Reserve Bank of Chicago fourth quarter, 34-51.

[16] Diebold, F.X., Lee, C., 2006. Forecasting the term structure of government bond yields. Journal of Econometrics 130, 337-264.

[17] Drehmann, M., Sorensen, S., Stringa, M., 2010. The integrated impact of credit and interest rate risk on banks: A dynamic framework and stress testing application. Journal of Banking and Finance 34, 713-729.

[18] Drucker, S., Puri, M., 2009. On loan sales, loan contracting and lending relationships. Review of Financial Studies 22, 2835-2872.

[19] Elyasiani, E., Mansur, I., 1998. Sensitivity of the bank stock returns distribution to changes in the level and volatility of interest rate: a GARCH-M model. Journal of Banking and Finance 22, 535-563.

[20] Erkens, D., Hung, M., Matos, P., 2009. Corporate governance in the recent financial crisis: evidence from financial institutions worldwide. University of Southern California, Marshall School of Business, Working paper series.

[21] Flannery, M.J., James, C.M., 1984. Market evidence on the effective maturity of bank assets and liabilities. Journal of Money, Credit and Banking 16, 435-445.

[22] Flannery, M.J., Hameed, A.S.,Harjes, R.H., 1997. Asset pricing, time-varying risk premia and interest rate risk. Journal of Banking and Finance 21, 315–335.

[23] French, K.R., 1980. Stock returns and the weekend effect. Journal of Financial Economics 8, 55–69.

[24] Gorton, G.B., Pennacchi, G.G., 1995. Banks and loan sales: Marketing nonmarketable assets. Journal of Monetary Economics 35, 389-411.

[25] Greenbaum, S.I., Thakor, A.V., 1987. Bank funding modes: Securitization versus deposits. Journal of Banking and Finance 11, 379-401.

[26] Hicks, J.R., 1946. Value and capital. Oxford: Clarendon Press.

[27] Keswani, A., Marsh, I.W., Zagonov, M., 2011. Bank regulations and interest rate risk: an international perspective. Cass Business School and Toulouse Business School, Working paper series.

[28] Keys, B.J., Mukherjee, T.K., Seru, A., Vig, V., 2010. Did securitization lead to lax screening? Evidence from subprime loans. Quarterly Journal of Economics 125, 307-362.

[29] Laeven, L., Levine, R., 2007. Is there a diversification discount in financial conglomerates? Journal of Financial Economics 85, 331-367.

[30] Longstaff, F.A., 2010. The subprime credit crisis and contagion in financial markets. Journal of Financial Economics 97, 436-450.

[31] Loutskina, E., Strahan, P.E., 2009. Securitization and the declining impact of bank finance on loan supply: evidence from mortgage originations. Journal of Finance 64, 861-889.

[32] Mian, A.R., Sufi, A., 2009. The consequences of mortgage credit expansion: Evidence from the U.S. mortgage default crisis. Quarterly Journal of Economics 124, 1449–1496.

[33] Nelson, C.R., Siegel, A.F., 1987. Parsimonious modeling of yield curve. Journal of Business 60, 473-489

[34] Pettengill, G.N., Wingender, J.R. , Kohli, R., 2003. Arbitrage, institutional investors, and the Monday effect. Quarterly Journal of Business and Economics 42, 49-63.

[35] Purnanandam, A.K., 2007. Interest rate derivatives at commercial banks: An empirical investigation. Journal of Monetary Economics 54, 1769-1808

[36] Purnanandam, A.K., 2011. Originate-to-distribute model and the subprime mortgage crisis. Review of Financial Studies 24, 1881-1915.

[37] Redington, F.M., 1952. Review of the principles of life office valuations. Journal of the Institute of Actuaries 78, 286-340.

[38] Samuelson, P., 1945. The effects of interest rate increases on the banking system. American Economic Review 35, 16-27.

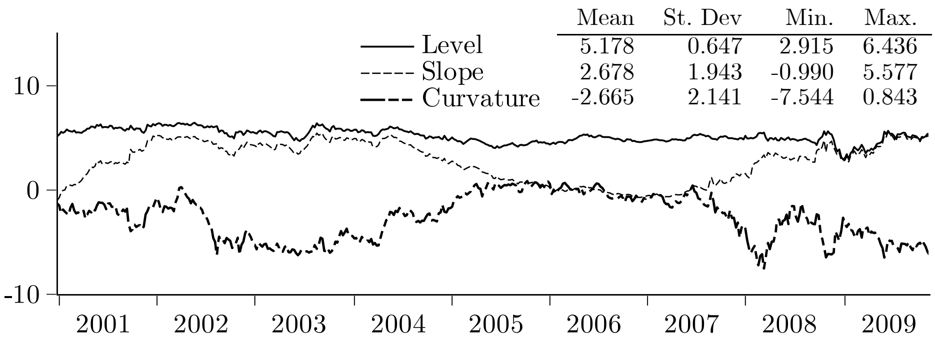
[39] Skreta, V., Veldkamp, L., 2009. Ratings shopping and asset complexity: A theory of ratings inflation. Journal of Monetary Economics 56, 678-695.

[40] Smith, R., Staikouras, C., Wood, G., 2003. Non-interest income and total income stability. Bank of England, Working paper series No 198.

[41] Stone, B.K., 1974. Systematic interest rate risk in a two-index model of returns. Journal of Financial and Quantitative Analysis 9, 709-721.

[42] Trzcinka, C., 1986. On the number of factors in the arbitrage pricing model. Journal of Finance 41, 347-368.

Figure 1. US zero-coupon yield curve level, slope and curvature



This figure depicts time-series plots of the Nelson and Siegel (1978) zero-coupon yield curve factors for the US over the 2001 to 2009 period. Shown are the estimates of the interest rate yield curve level (β_1), slope (β_2) and curvature (β_3).

Table 1: Bank loan sales and securitization activities by year

This table presents the summary statistics of the US publically traded bank holding companies (BHCs) securitization and assets sales activities by year. Reported are the average values of assets by category, expressed as a proportion of BHCs' total assets, securitized or sold within a given year, and the percentage of BHCs (*in italics*) involved in issuance of new securitization and loan sales transactions in the same year. The respective data are compiled from Schedule HC-S of the Federal Reserve System's FY-9C filings for a sample of 304 financial intermediaries analysed in this study.

	2001	2002	2003	2004	2005	2006	2007	2008
Loan sales								
1-4 family residential	0.0424	0.0226	0.0129	0.0164	0.0146	0.0075	0.0062	0.0087
	13.36%	*11.30%*	*11.82%*	*12.58%*	*12.58%*	*12.58%*	*13.25%*	*13.71%*
Home equity lines	0.0000	0.0000	0.0000	0.0000	0.0001	0.0040	0.0024	0.0002
	0.00%	*0.00%*	*0.00%*	*0.00%*	*0.33%*	*0.99%*	*0.66%*	*0.67%*
Credit card receivables	0.0005	0.0000	0.0003	0.0004	0.0000	0.0001	0.0000	0.0006
	2.53%	*1.37%*	*2.36%*	*2.65%*	*1.99%*	*1.99%*	*2.32%*	*2.34%*
Auto loans	0.0000	0.0001	0.0000	0.0000	0.0000	0.0014	0.0000	0.0152
	0.00%	*0.34%*	*0.00%*	*0.33%*	*0.00%*	*0.33%*	*0.00%*	*0.33%*
Other consumer loans	0.0044	0.0091	0.0003	0.0000	0.0000	0.0000	0.0000	0.0003
	1.08%	*0.34%*	*0.34%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.33%*
C&I loans	0.0126	0.0020	0.0028	0.0018	0.0051	0.0017	0.0107	0.0001
	2.53%	*2.40%*	*2.36%*	*2.65%*	*2.32%*	*1.99%*	*0.66%*	*0.33%*
Other loans	0.0143	0.0019	0.0033	0.0089	0.0040	0.0100	0.0312	0.0168
	0.72%	*1.03%*	*1.69%*	*2.65%*	*1.66%*	*1.32%*	*1.99%*	*3.34%*
Loan securitization								
1-4 family residential	0.2218	0.0708	0.0641	0.0342	0.0412	0.0562	0.0325	0.0497
	11.55%	*8.22%*	*6.42%*	*6.29%*	*4.97%*	*4.30%*	*4.30%*	*5.35%*
Home equity lines	0.0086	0.0021	0.0033	0.0093	0.0120	0.0037	0.0000	0.0033
	1.81%	*0.68%*	*1.01%*	*1.66%*	*1.32%*	*0.99%*	*0.33%*	*1.67%*
Credit card receivables	0.0274	0.0049	0.0055	0.0147	0.0101	0.0160	0.0108	0.0060
	1.44%	*1.03%*	*0.68%*	*0.99%*	*0.99%*	*1.99%*	*1.32%*	*1.67%*
Auto loans	0.0147	0.0133	0.0286	0.0119	0.0086	0.0126	0.0203	0.0118
	5.42%	*1.71%*	*2.03%*	*1.99%*	*0.99%*	*1.32%*	*0.33%*	*1.67%*
Other consumer loans	0.0110	0.0031	0.0036	0.0041	0.0040	0.0074	0.0007	0.0011
	2.89%	*1.03%*	*0.68%*	*0.66%*	*1.32%*	*1.66%*	*0.99%*	*1.00%*
C&I loans	0.0264	0.0111	0.0046	0.0036	0.0048	0.0043	0.0029	0.0006
	3.61%	*3.08%*	*2.36%*	*1.66%*	*1.32%*	*1.99%*	*1.32%*	*1.67%*
Other loans	0.0128	0.0055	0.0138	0.0054	0.0094	0.0096	0.0069	0.0246
	2.53%	*2.05%*	*2.70%*	*2.98%*	*2.98%*	*3.97%*	*3.97%*	*2.01%*

Table 2: Selected characteristics of bank holding companies

This table provides a comparison of selected financial characteristics for securitisers and non-securitisers over the 2001 to 2009 period. A bank holding company (BHC) is defined as securitiser if it reports at least one securitisation transaction over the analysed period in Schedule HC-S of the Federal Reserve System's FY-9C filings. Reported are the mean [median] values of the considered accounting variables. This includes an institution's asset growth rate (AGR); equity capital (CAP) calculated as the ratio of BHC's book value of equity capital to its total assets; the Herfindahl-Hirschman (non)interest revenue concentration index H_NITR(H_NOIR) calculated on the basis of twelve (eight) part breakdown of the (non)interest income; the proportion of total assets that are liquid (LATA); the Herfindahl-Hirschman loan concentration index (H_LOAN) computed considering five loan categories; the bank's provision for loan and lease losses scaled by total loans (LLP); maturity gap (GAP) calculated as the difference between interest-earning assets and interest-bearing liabilities maturing or being repriced within one year, scaled by the bank's total assets; the net credit protection (protection bought minus sold) NECP purchased by a bank; the ratio of non-performing loans to total loans is NPL; return on assets (ROA); the measure of bank revenue diversification (ROID); and the ratio of the institution's risk-weighted to total assets (TRA). The economic environment is proxied by the annual growth rate in the gross domestic product (GDPG), and the Aruoba-Diebold-Scotti Business Conditions Index (ADSI). ***, **, and * denote statistical significance at the 1%, 5%, and 10% level respectively for an appropriate mean [median] equality test.

Variable	Securitizers mean/[median]	Non-securitizers mean/[median]	All BHCs mean/[median]	Equality test mean/[median]
Panel A: BHC financial characteristics				
Asset growth rate	0.101	0.126	0.121	1.04
AGR	[0.077]	[0.091]	[0.088]	[3.03***]
Capitalisation	0.098	0.091	0.093	-3.20***
CAP	[0.088]	[0.088]	[0.088]	[0.34]
Interest income HHI	0.076	0.064	0.067	-1.96*
H_NITR	[0.019]	[0.016]	[0.017]	[4.54***]
Liquidity	0.264	0.261	0.262	-0.45
LATA	[0.242]	[0.238]	[0.239]	[0.37]
Loan HHI	0.530	0.608	0.590	10.51***
H_LOAN	[0.530]	[0.601]	[0.582]	[10.34***]
Loan loss provision	0.006	0.004	0.005	-5.66***
LLP	[0.004]	[0.003]	[0.003]	[6.34***]
Maturity gap	0.177	0.160	0.164	-2.56**
GAP	[0.141]	[0.130]	[0.132]	[2.09**]
Net credit protection	6.54E-04	1.38E-05	1.61E-04	-3.66***
NECP	[0.000]	[0.000]	[0.000]	[0.48]
Non-interest income HHI	0.177	0.213	0.205	5.02***
H_NOIR	[0.142]	[0.191]	[0.177]	[6.72***]
Non-performing loans	0.012	0.010	0.010	-4.16***
NPL	[0.008]	[0.006]	[0.006]	[7.77***]
Return on assets	0.012	0.009	0.009	-4.78***
ROA	[0.011]	[0.010]	[0.010]	[3.59***]
Revenue Diversification	0.427	0.330	0.352	-10.56***
ROID	[0.409]	[0.300]	[0.315]	[9.94***]
Total risk adjusted assets	0.749	0.740	0.742	-1.37
TRA	[0.758]	[0.748]	[0.750]	[1.58]
Panel B: Economic environment characteristics				
GDP growth	0.017	0.023	0.021	13.93***
GDPG	[0.020]	[0.025]	[0.025]	[14.21***]
Business conditions index	-0.952	-0.095	-0.422	57.01***
ADSI	[-1.077]	[-0.130]	[-0.155]	[35.79***]

Table 3: Correlation matrix for selected variables

This table presents the bivariate correlations between the considered explanatory variables. Spearman (Pearson) correlation coefficients are above (below) the diagonal. Variable definitions and sources are provided in Appendix B. $p-$values are in parentheses.

	AGR	**CAP**	**H_NITR**	**LATA**	**H_LOAN**	**LLP**	**GAP**	**NECP**	**H_NOIR**	**NPL**	**ROA**	**ROID**	**TRA**	**GDPG**	**ADSI**	**TSEC**
AGR		-0.134	-0.138	-0.087	0.133	-0.064	0.058	0.013	-0.057	-0.228	-0.007	-0.111	0.086	0.084	0.141	-0.030
		(0.000)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.002)*	*(0.007)*	*(0.545)*	*(0.007)*	*(0.000)*	*(0.740)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.163)*
CAP	0.022		-0.028	-0.059	0.006	-0.079	0.073	-0.047	-0.022	0.050	0.257	0.079	0.085	-0.019	-0.068	0.037
	(0.309)		*(0.190)*	*(0.006)*	*(0.771)*	*(0.000)*	*(0.001)*	*(0.027)*	*(0.308)*	*(0.019)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.366)*	*(0.001)*	*(0.083)*
H_NITR	0.100	0.046		0.593	-0.092	0.150	-0.120	0.045	0.069	0.170	-0.194	0.070	-0.505	-0.345	-0.135	0.121
	(0.000)	*(0.032)*		*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.033)*	*(0.001)*	*(0.000)*	*(0.000)*	*(0.001)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*
LATA	0.091	0.037	0.135		-0.156	-0.198	-0.135	0.044	0.074	-0.126	0.087	0.093	-0.800	0.052	0.220	0.037
	(0.000)	*(0.079)*	*(0.000)*		*(0.000)*	*(0.000)*	*(0.000)*	*(0.040)*	*(0.001)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.014)*	*(0.000)*	*(0.083)*
H_LOAN	0.029	-0.038	0.106	-0.046		-0.244	-0.141	-0.022	0.084	-0.154	-0.152	-0.346	-0.003	0.047	-0.051	-0.258
	(0.167)	*(0.071)*	*(0.000)*	*(0.029)*		*(0.000)*	*(0.000)*	*(0.309)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.890)*	*(0.027)*	*(0.015)*	*(0.000)*
LLP	-0.053	0.055	0.416	-0.160	-0.146		0.023	-0.044	-0.035	0.552	-0.276	0.036	0.195	-0.420	-0.194	0.170
	(0.012)	*(0.009)*	*(0.000)*	*(0.000)*	*(0.000)*		*(0.276)*	*(0.039)*	*(0.098)*	*(0.000)*	*(0.000)*	*(0.091)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*
GAP	-0.004	0.161	-0.059	-0.096	-0.131	-0.004		-0.014	-0.115	-0.070	0.121	0.149	0.238	0.064	0.078	0.084
	(0.840)	*(0.000)*	*(0.006)*	*(0.000)*	*(0.000)*	*(0.838)*		*(0.514)*	*(0.000)*	*(0.001)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.003)*	*(0.000)*	*(0.000)*
NECP	-0.001	-0.021	0.026	0.018	-0.086	0.087	-0.031		0.045	-0.037	-0.002	0.067	-0.048	-0.003	-0.029	0.052
	(0.964)	*(0.320)*	*(0.216)*	*(0.391)*	*(0.000)*	*(0.000)*	*(0.147)*		*(0.032)*	*(0.081)*	*(0.911)*	*(0.002)*	*(0.025)*	*(0.874)*	*(0.177)*	*(0.015)*
H_NOIR	-0.012	-0.010	0.021	0.011	-0.041	0.133	-0.026	0.451		-0.006	-0.087	-0.186	-0.160	-0.013	-0.069	-0.210
	(0.575)	*(0.636)*	*(0.313)*	*(0.616)*	*(0.052)*	*(0.000)*	*(0.229)*	*(0.000)*		*(0.767)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.550)*	*(0.001)*	*(0.000)*
NPL	-0.079	-0.043	0.445	-0.082	-0.008	0.603	-0.078	0.031	0.057		-0.274	0.007	0.100	-0.341	-0.242	0.161
	(0.000)	*(0.043)*	*(0.000)*	*(0.000)*	*(0.718)*	*(0.000)*	*(0.000)*	*(0.140)*	*(0.007)*		*(0.000)*	*(0.751)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*
ROA	0.006	0.609	-0.253	0.132	-0.102	-0.355	0.147	-0.022	-0.048	-0.334		0.241	-0.004	0.229	0.253	0.089
	(0.764)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.307)*	*(0.022)*	*(0.000)*		*(0.000)*	*(0.859)*	*(0.000)*	*(0.000)*	*(0.000)*
ROID	0.003	-0.050	-0.052	0.086	-0.341	0.010	0.150	0.055	-0.040	-0.083	0.105		-0.061	0.088	0.183	0.219
	(0.871)	*(0.017)*	*(0.014)*	*(0.000)*	*(0.000)*	*(0.653)*	*(0.000)*	*(0.009)*	*(0.059)*	*(0.000)*	*(0.000)*		*(0.004)*	*(0.000)*	*(0.000)*	*(0.000)*
TRA	-0.074	-0.047	-0.118	-0.813	-0.092	0.136	0.205	-0.042	-0.042	0.075	-0.098	-0.017		0.005	-0.151	0.028
	(0.001)	*(0.025)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.049)*	*(0.049)*	*(0.000)*	*(0.000)*	*(0.421)*		*(0.804)*	*(0.000)*	*(0.187)*
GDPG	0.022	-0.008	-0.506	0.069	0.037	-0.379	0.067	-0.016	-0.036	-0.336	0.203	0.093	-0.005		0.644	-0.023
	(0.295)	*(0.714)*	*(0.000)*	*(0.001)*	*(0.078)*	*(0.000)*	*(0.001)*	*(0.444)*	*(0.090)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.818)*		*(0.000)*	*(0.274)*
ADSI	0.052	-0.042	-0.337	0.211	-0.080	-0.244	0.060	-0.065	-0.027	-0.273	0.182	0.117	-0.177	0.479		0.009
	(0.014)	*(0.046)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.004)*	*(0.002)*	*(0.195)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*		*(0.664)*
TSEC	-0.004	0.039	0.013	-0.013	-0.073	0.106	0.057	0.086	0.069	0.103	0.051	0.212	0.001	-0.029	0.011	
	(0.867)	*(0.067)*	*(0.525)*	*(0.536)*	*(0.001)*	*(0.000)*	*(0.008)*	*(0.000)*	*(0.001)*	*(0.000)*	*(0.016)*	*(0.000)*	*(0.959)*	*(0.170)*	*(0.606)*	

Table 4: Selected BHCs' market measures of risk

This table provides a comparison of selected measures of market risk for securitisers and non-securitisers over the 2001 to 2009 period. A bank holding company (BHC) is defined as securitiser if it reports at least one securitisation transaction over the analysed period in Schedule HC-S of the Federal Reserve System's FY-9C filings. Reported are the mean [median] values of pertinent risk measures. The market measures of risk are represented by the coefficient estimates from a four factor GARCH market model. Specifically, for each bank-year, I run a four-factor time series regression of BHC weekly returns on the market returns (MRK), and unanticipated changes in zero-coupon yield curve level (LEV), slope (SLO), and curvature (CUR). The estimation requires at least 30 weekly return observations for each bank-year. The corresponding US zero-coupon yield curve level, slope, and curvature are estimated using Diebold and Lee (2006) parameterisation of the Nelson and Siegel (1987) model. The unanticipated changes in the yield curve factors at time $t$are calculated as the difference between the actual changes in these factors and ones forecasted via an appropriate specification of the autoregressive moving average (ARMA) model. The percentage of coefficients significant at the 5% level (% of which is negative) is in italics. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level respectively for an appropriate mean [median] equality test.

Variable	Securitizers mean/[median]	Non-securitizers mean/[median]	All BHCs mean/[median]	Equality test mean/[median]
Systematic risk	9.72E-01	6.62E-01	7.32E-01	-8.78***
	[9.04E-01]	[5.78E-01]	[6.63E-01]	[8.99***]
Significance at 5% level	*75.00%*	*49.62%*	*55.35%*	
IR Level	7.14E-04	1.16E-03	1.06E-03	0.15
	[2.66E-03]	[2.24E-04]	[7.29E-04]	[0.58]
Significance at 5% level	*9.51%*	*7.30%*	*7.80%*	
% negative	*-47.06%*	*-46.27%*	*-46.49%*	
IR Slope	-9.94E-03	-8.57E-03	-8.88E-03	0.35
	[-9.88E-03]	[-9.44E-03]	[-9.61E-03]	[0.02]
Significance at 5% level	*11.94%*	*9.64%*	*10.16%*	
% negative	*-68.75%*	*-72.88%*	*-71.78%*	
IR Curvature	6.27E-05	-8.60E-04	-6.52E-04	-0.86
	[3.84E-04]	[-4.95E-07]	[-6.78E-08]	[0.77]
Significance at 5% level	*13.99%*	*7.24%*	*8.77%*	
% negative	*-61.33%*	*-67.67%*	*-65.39%*	

Table 5: Interest rate risk and securitisation by maturity category

This table presents the panel estimation results for the regression which evaluates bank holding companies' (BHC) interest rate risk with respect to the maturity of securitised assets over the 2001 to 2009 period. The dependent variable is the absolute value of the coefficient measuring the sensitivity of BHC's *i* equity returns to unanticipated changes in the level (Panel A), slope (Panel B), and curvature (Panel C) of the US sovereign zero-coupon yield curve at year *t*. The explanatory variables are as follows: TSEC is the outstanding principle balance of assets securitised or sold measured as the proportion of total assets; the outstanding balance of securitised long-, medium-, and short-term loans are LT˙SEC, MT˙SEC, and ST˙SEC respectively; the asset growth rate (AGR); equity capital (CAP) calculated as the ratio of BHC's book value of equity capital to its total assets; H˙NITR(H˙NOIR) is the Herfindahl-Hirschman (non)interest revenue concentration index calculated on the basis of twelve (eight) part breakdown of the (non)interest income; the proportion of total assets that are liquid (LATA); H˙LOAN is the Herfindahl-Hirschman loan concentration index computed considering five loan categories; GAP is the balance sheet maturity gap calculated as the difference between interest-earning assets and interest-bearing liabilities maturing or being repriced within one year, scaled by the bank's total assets; NECP is the net credit protection (protection bought minus sold) purchased by a bank; the ratio of non-performing loans to total loans is NPL; ROID is the measure of bank revenue diversification; return on assets is represented by ROA. The regression also includes year- and state-dummies (not reported). Heteroskedasticity and autocorrelation consistent *t*-values based on White's robust standard error are in italics. ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Yield curve level exposure								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Securitisers				All bank holding companies			
TSEC	0.053				0.025			
	3.61***				2.59***			
LT˙SEC		0.053				0.028		
		3.52***				2.76***		
MT˙SEC			-0.015				-0.091	
			-0.04				-0.33	
ST˙SEC				0.196				-0.026
				1.44				-0.49
AGR	-0.028	-0.028	-0.026	-0.030	0.004	0.004	0.004	0.004
	-2.06**	-2.00**	-1.79*	-2.04**	1.95*	1.96**	1.98**	1.97**
CAP	-0.197	-0.199	-0.100	-0.081	-0.180	-0.179	-0.177	-0.176
	-1.02	-1.02	-0.51	-0.41	-2.89***	-2.88***	-2.84***	-2.82***
CAP^2	0.564	0.570	0.440	0.375	0.292	0.295	0.292	0.296
	2.14**	2.14**	1.65	1.38	3.14***	3.17***	3.14***	3.17***
H˙NITR	-0.060	-0.059	-0.072	-0.074	-0.039	-0.038	-0.041	-0.040
	-1.75*	-1.70*	-2.06**	-2.14**	-2.29**	-2.25**	-2.38**	-2.35**
LATA	0.063	0.061	0.062	0.068	0.010	0.010	0.010	0.009
	2.19**	2.12**	2.13**	2.31**	1.08	1.05	1.02	0.99
H˙LOAN	0.050	0.048	0.064	0.071	0.030	0.030	0.031	0.031
	2.30**	2.18**	2.93***	3.18***	4.09***	4.00***	4.16***	4.08***
GAP	0.004	0.004	0.003	0.002	0.015	0.014	0.015	0.015
	0.20	0.19	0.14	0.11	1.97**	1.95*	2.04**	2.02**
NECP	0.476	0.484	0.552	0.530	0.819	0.825	0.875	0.883
	1.42	1.44	1.62	1.56	3.19***	3.21***	3.41***	3.43***
H˙NOIR	0.000	0.000	0.000	0.000	0.005	0.006	0.005	0.005
	1.37	1.41	1.67*	1.50	0.73	0.78	0.67	0.69
NPL	0.702	0.718	0.810	0.751	0.796	0.795	0.817	0.819
	3.21***	3.28***	3.68***	3.36***	8.56***	8.55***	8.81***	8.82***
ROA	-1.574	-1.551	-1.506	-1.472	-0.411	-0.410	-0.401	-0.403
	-4.55***	-4.46***	-4.27***	-4.18***	-3.23***	-3.22***	-3.15***	-3.16***
ROID	-0.008	-0.008	0.005	-0.001	-0.010	-0.010	-0.007	-0.006
	-0.54	-0.49	0.32	-0.03	-1.68*	-1.66*	-1.13	-1.03
Constant	0.027	0.028	0.007	0.003	0.006	0.006	0.005	0.004
	0.93	0.95	0.24	0.10	0.33	0.34	0.24	0.24
Observations	516	516	516	516	2225	2225	2225	2225
BHCs	68	68	68	68	304	304	304	304
Period fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.23	0.23	0.21	0.22	0.14	0.14	0.14	0.14

Panel B: Yield curve slope exposure								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Securitisers				All bank holding companies			
TSEC	0.083				0.053			
	3.98***				4.00***			
LT˙SEC		0.085				0.056		
		3.98***				4.12***		
MT˙SEC			0.057				-0.422	
			0.11				-1.12	
ST˙SEC				0.223				0.004
				1.14				0.05
AGR	-0.037	-0.036	-0.033	-0.037	0.000	0.000	0.000	0.000
	-1.90*	-1.81*	-1.59	-1.76*	-0.16	-0.14	-0.09	-0.12
CAP	-0.151	-0.148	0.023	0.044	-0.011	-0.009	-0.003	-0.005
	-0.55	-0.54	0.08	0.16	-0.13	-0.10	-0.04	-0.06
CAP^2	0.376	0.374	0.150	0.077	0.057	0.062	0.056	0.057
	1.00	0.99	0.39	0.20	0.45	0.50	0.44	0.45
H˙NITR	0.022	0.026	0.005	0.001	0.000	0.001	-0.004	-0.004
	0.46	0.53	0.09	0.03	-0.01	0.04	-0.16	-0.15
LATA	0.087	0.085	0.088	0.094	0.017	0.016	0.015	0.016
	2.14**	2.09**	2.11**	2.25**	1.32	1.27	1.20	1.24
H˙LOAN	0.034	0.029	0.054	0.061	0.017	0.015	0.018	0.018
	1.10	0.92	1.73*	1.93*	1.67*	1.54	1.74*	1.79*
GAP	-0.010	-0.009	-0.011	-0.012	-0.001	-0.001	0.000	0.000
	-0.35	-0.33	-0.40	-0.43	-0.12	-0.12	0.01	0.00
NECP	0.324	0.334	0.443	0.419	0.061	0.078	0.184	0.175
	0.68	0.70	0.91	0.86	0.18	0.23	0.53	0.50
H˙NOIR	0.000	0.000	0.000	0.000	-0.007	-0.006	-0.008	-0.007
	-1.81*	-1.79*	-1.45	-1.57	-0.67	-0.60	-0.79	-0.75
NPL	0.345	0.362	0.513	0.445	0.490	0.489	0.535	0.535
	1.11	1.16	1.63	1.39	3.89***	3.88***	4.25***	4.24***
ROA	-1.516	-1.480	-1.402	-1.365	-0.472	-0.473	-0.457	-0.454
	-3.07***	-2.99***	-2.79***	-2.71***	-2.74***	-2.75***	-2.64***	-2.62***
ROID	-0.031	-0.033	-0.013	-0.019	-0.014	-0.014	-0.007	-0.007
	-1.42	-1.51	-0.61	-0.85	-1.69*	-1.67*	-0.84	-0.88
Constant	0.037	0.038	0.005	0.000	0.047	0.047	0.044	0.043
	0.89	0.93	0.11	0.01	1.84*	1.85*	1.71*	1.69*
Observations	516	516	516	516	2225	2225	2225	2225
BHCs	68	68	68	68	304	304	304	304
Period fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.18	0.19	0.16	0.16	0.10	0.10	0.10	0.10

Panel C: Yield curve curvature exposure								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Securitisers				All bank holding companies			
TSEC	0.013				0.008			
	*2.61****				*2.50***			
LT˙SEC		0.013				0.008		
		*2.58***				*2.19***		
MT˙SEC			0.028				0.006	
			0.23				*0.06*	
ST˙SEC				*0.076*				*0.034*
				1.68*				1.84*
AGR	-0.002	-0.002	-0.002	-0.003	0.003	0.003	0.003	0.003
	-0.55	*-0.51*	*-0.41*	*-0.68*	*4.52****	*4.51****	*4.51****	*4.51****
CAP	-0.089	-0.086	-0.056	-0.049	-0.021	-0.021	-0.020	-0.022
	-1.38	*-1.33*	*-0.87*	*-0.76*	*-0.97*	*-0.98*	*-0.95*	*-1.05*
CAP^2	0.174	*0.168*	*0.129*	*0.104*	0.040	*0.041*	*0.040*	*0.036*
	*1.97***	*1.90**	*1.46*	*1.17*	*1.25*	*1.28*	*1.25*	*1.13*
H˙NITR	-0.023	*-0.022*	*-0.026*	*-0.027*	-0.013	*-0.013*	*-0.014*	*-0.014*
	*-2.00***	*-1.93**	*-2.22***	*-2.33***	*-2.29***	*-2.27***	*-2.37***	*-2.45***
LATA	0.013	*0.013*	*0.014*	*0.016*	-0.003	*-0.003*	*-0.003*	*-0.002*
	1.39	*1.37*	*1.41*	*1.63*	*-0.85*	*-0.88*	*-0.88*	*-0.74*
H˙LOAN	0.002	*0.001*	*0.004*	*0.007*	0.000	*0.000*	*0.001*	*0.001*
	0.24	*0.11*	*0.60*	*0.94*	*0.15*	*0.10*	*0.24*	*0.47*
GAP	-0.002	-0.002	-0.003	-0.003	0.002	0.002	0.002	0.002
	-0.38	*-0.33*	*-0.41*	*-0.44*	*0.63*	*0.70*	*0.75*	*0.81*
NECP	0.079	0.081	0.097	0.090	-0.021	-0.016	-0.003	-0.016
	0.70	*0.72*	*0.87*	*0.80*	*-0.24*	*-0.18*	*-0.03*	*-0.18*
H˙NOIR	0.000	*0.000*	*0.000*	*0.000*	0.000	*0.001*	*0.000*	*0.000*
	*-2.07***	*-2.07***	*-1.87**	*-2.04***	*0.12*	*0.20*	*0.12*	*0.09*
NPL	-0.021	*-0.020*	*0.004*	*-0.019*	0.128	*0.128*	*0.134*	*0.132*
	-0.29	*-0.27*	*0.05*	*-0.26*	*4.01****	*4.02****	*4.23****	*4.14****
ROA	-0.344	*-0.332*	*-0.318*	*-0.306*	-0.102	*-0.100*	*-0.098*	*-0.094*
	*-2.98****	*-2.88****	*-2.74****	*-2.64****	*-2.33***	*-2.30***	*-2.23***	*-2.15***
ROID	-0.011	-0.012	-0.009	-0.011	-0.007	-0.007	-0.006	-0.006
	*-2.13***	*-2.30***	*-1.75**	*-2.09***	*-3.18****	*-3.15****	*-2.78****	*-3.09****
Constant	0.031	0.031	0.026	0.025	0.018	0.018	0.018	0.018
	*3.25****	*3.26****	*2.75****	*2.60****	*2.80****	*2.79****	*2.71****	*2.72****
Observations	516	516	516	516	2225	2225	2225	2225
BHCs	68	68	68	68	304	304	304	304
Period fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.15	0.16	0.14	0.15	0.11	0.11	0.11	0.11

Table 6: Nonlinearity between interest rate risk and securitization

This table presents the panel estimation results for the regression which evaluates the bank holding companies' (BHC) interest rate risk with respect to the maturity of securitized assets over the 2001 to 2009 period. The dependent variable is the absolute value of the coefficient measuring the sensitivity of BHC's i equity returns to unanticipated changes in the level (columns 1-5), slope (columns 6-10), and curvature (columns 11-15) of the US sovereign zero-coupon yield curve at year t. Only BHCs reporting at least one securitization transaction over the analysed period in Schedule HC-S of the Federal Reserve System's FY-9C filings are considered. The explanatory variables on the right-hand side are as follows: TSEC is the outstanding principle balance of assets securitized or sold measured as the proportion of total assets; the outstanding balance of securitized long-, medium-, and short-term loans are LT˙SEC, MT˙SEC, and ST˙SEC respectively; the ratio (and the squared ratio) of book value of equity capital to bank's total assets CAP. Each regression also includes year- and state- dummies, and the following firm-specific variables which are not reported: the asset growth rate (AGR); the proportion of total assets that are liquid (LATA); H˙LOAN is the Herfindahl-Hirschman loan concentration index computed considering five loan categories; NECP is the net credit protection (protection bought minus sold) purchased by a bank; the ratio of non-performing loans to total loans is NPL; ROID is the measure of bank revenue diversification; and return on assets is represented by ROA. The regressions in columns 2, 7, and 12 also incorporate the economic environment proxies (not reported) as follows: annual growth rate in the gross domestic product (GDPG), and the Aruoba-Diebold-Scotti Business Conditions Index (ADSI). When the economic environment proxies are added, the time-fixed effect is relaxed. Heteroskedasticity and autocorrelation consistent t-values based on White's robust standard error are in italics. ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
	Level					Slope					Curvature				
TSEC	0.102	0.093				0.112	0.098				0.014	0.013			
	*3.95****	*3.47****				*3.06****	*2.66****				*1.65**	*1.43*			
$TSEC^2$	-0.028	-0.027				-0.026	-0.026				-0.003	-0.003			
	*-1.80**	*-1.65**				*-1.15*	*-1.12*				*-0.52*	*-0.60*			
LT˙SEC			0.103					0.115					0.014		
			*3.79****					*3.02****					*1.61*		
$LT˙SEC^2$			-0.028					-0.027					-0.003		
			*-1.74**					*-1.16*					*-0.51*		
MT˙SEC				0.610					0.748					0.365	
				0.71					*0.62*					*1.30*	
$MT˙SEC^2$				-11.013					-14.521					-6.705	
				-0.71					*-0.67*					*-1.34*	
ST˙SEC					0.342					0.352					0.026
					*2.08***					*1.53*					*0.48*
$ST˙SEC^2$					-0.269					-0.713					0.070
					-0.55					*-1.04*					*0.44*
CAP	-0.271	-0.197	-0.274	-0.108	-0.094	-0.187	-0.008	-0.190	0.013	0.030	-0.122	-0.089	-0.121	-0.094	-0.089
	-1.40	*-0.99*	*-1.40*	*-0.55*	*-0.48*	*-0.68*	*-0.03*	*-0.69*	*0.05*	*0.11*	*-1.89**	*-1.36*	*-1.87**	*-1.47*	*-1.40*
CAP^2	0.726	0.678	0.741	0.502	0.429	0.490	0.466	0.506	0.213	0.140	0.232	0.222	0.231	0.190	0.180
	*2.79****	*2.52***	*2.82****	*1.91**	*1.65**	*1.33*	*1.25*	*1.37*	*0.58*	*0.38*	*2.68****	*2.52***	*2.66****	*2.23***	*2.09***
Observations	516	516	516	516	516	516	516	516	516	516	516	516	516	516	516
BHCs	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68
Period fixed effect	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
State fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.22	0.16	0.22	0.18	0.19	0.18	0.15	0.18	0.16	0.16	0.14	0.10	0.14	0.13	0.13

Table 7: Robustness test (yield curve level)

This table presents the panel estimation results for the regressions which evaluate the bank holding companies' (BHC) interest rate risk with respect to securitisation, using different time horizons (column "Crisis"); subsamples (columns "SIZE", "LATA", "NDUS"); and the model econometric specifications (column "2SLS"). The dependent variable is the absolute value of the coefficient measuring the sensitivity of BHC *i*'s equity returns to unanticipated changes in the level of the US sovereign zero-coupon yield curve at year *t*. These coefficients are estimated from a four factor GARCH market model. Specifically, for each bank-year, I run a four-factor time series regression of BHC weekly returns on the market returns (MRK), and unanticipated changes in yield curve level (LEV), slope (SLO), and curvature (CUR). The estimation requires at least 30 weekly return observations for each bank-year. The corresponding US zero-coupon yield curve level, slope, and curvature are estimated using Diebold and Lee (2006) parameterisation of Nelson and Siegel (1987) model. The unanticipated changes in the yield curve factors at time t are calculated as the difference between the actual changes in these factors and ones forecasted via an appropriate specification of the autoregressive moving average (ARMA) model. Only BHCs reporting at least one securitisation transaction over the analysed period in Schedule HC-S of the Federal Reserve System's FY-9C filings are considered. Reported are the coefficient estimates for the TSEC explanatory variable, which represents the outstanding principle balance of assets securitised or sold as the proportion of total assets. Each regression also includes year- and state-dummies, and the following firm-specific variables which are not reported: the ratio (and the squared ratio) of book value of equity capital to bank's total assets (CAP); the asset growth rate (AGR); the proportion of total assets that are liquid (LATA); the Herfindahl-Hirschman loan concentration index computed considering five loan categories (H˙LOAN); the net credit protection (protection bought minus sold) purchased by a bank (NECP); the ratio of non-performing loans to total loans (NPL); the measure of bank revenue diversification (ROID); and return on assets (ROA). All BHCs are split into a number of sub-samples on the basis of ranking by the bank's size (column "SIZE"); liquidity (column "LATA"); and net derivative usage (column "NDUS"). Selected are the top 25% and the bottom 75% of values in each category with a total of six portfolios. Coefficients on TSEC are reported for each portfolio. The test statistics (*F*-statistics) for the Wald coefficient restriction test with the null hypothesis testing the equality of the coefficient estimates for the "Top 25%" and the "Bottom 75%" portfolios in each category is reported in column entitled "WALD", with the associated *p*-value reported in brackets below. Heteroskedasticity and autocorrelation consistent *t*-values based on White's robust standard error are reported in italics. ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively.

	2SLS	Crisis	SIZE	LATA	NDUS	WALD
TSEC	0.192					
	*3.77****					
Pre-crisis (2001-2006)		0.035				67.50
		*2.59****				*(0.000)*
Crisis (2007-2009)		0.244				
		*9.50****				
Top 25%			0.023			3.73
			0.94			*(0.054)*
Bottom 75%			0.084			
			*4.74****			
Top 25%				0.153		20.93
				*6.37****		*(0.000)*
Bottom 75%				0.018		
				1.04		
Top 25%					0.007	36.79
					0.40	*(0.000)*
Bottom 75%					0.177	
					*7.63****	
Observations	516	516	516	516	516	
BHCs	68	68	68	68	68	
Period fixed effect	Yes	No	Yes	Yes	Yes	
State fixed effect	Yes	Yes	Yes	Yes	Yes	
Adj. R^2	0.08	0.31	0.22	0.25	0.27	

Appendix A

Panel A: Securitisers

BHC name	RSSD ID	Ticker	BHC name	RSSD ID	Ticker
1st Source Corporation	1199602	SRCE	Guaranty Federal Bancshares, Inc.	2618940	GFED
AMCORE Financial, Inc.	1208661	AMFI	Huntington Bancshares, Inc.	1068191	HBAN
Arrow Financial Corporation	1048812	AROW	Independent Bank Corporation	1201925	IBCP
Associated Banc-Corp	1199563	ASBC	Indiana United Bancorp.	1209109	MSFG
Auburn National Bancorporation, Inc.	1129533	AUBN	International Bancshares Corporation	1104231	IBOC
Bank of America Corporation	1073757	BAC	Key Corp.	1068025	KEY
Bank of New York Company, Inc.	1033470	BK	LNB Bancorp, Inc.	1071669	LNBB
BOK Financial Corporation	1883693	BOKF	Marshall & Ilsley Corporation	1199497	MI
Camden National Corporation	1130249	CAC	MB Financial, Inc.	1090987	MBFI
Capital One Financial Corporation	2277860	COF	Mid Penn Bancorp, Inc.	1944204	MPB
Capitol Bancorp Ltd.	1247334	CBC	Monroe Bancorp	1210299	MROE
Carolina First Corporation	1141599	TSFG	Northern States Financial Corporation	1210589	NSFC
Charles Schwab Corporation	1026632	SCHW	Northrim Bancorp Inc.	3025385	NRIM
Citigroup, Inc.	1951350	C	Norwest Corporation	1120754	WFC
City Holding Company	1076262	CHCO	Pacific Capital Bancorp.	1029884	PCBC
Comm Bancorp, Incorporated	1118229	CCBP	Popular, Inc.	1129382	BPOP
Doral Financial Corporation	2184164	DRL	Regions Financial Corporation	1078332	RF
Eagle Bancorp, Inc.	2652104	EGBN	Republic Bancorp, Inc.	1097025	RBCAA
East West Bancorp, Inc.	2734233	EWBC	S.Y. Bancorp, Inc.	1249730	SYBT
Exchange National Bancshares, Inc.	2038409	HWBK	Santander Bancorp.	2847115	SBP
Fifth Third Bancorp	1070345	FITB	State Street Boston Corporation	1111435	STT
First BanCorp	2744894	FBP	SunTrust Banks, Inc.	1131787	STI
First Busey Corporation	1203602	BUSE	Susquehanna Bancshares, Inc.	1117156	SUSQ
First Citizens BancShares, Inc.	1075612	FCNCA	The Chase Manhattan Bank	1039502	JPM
First Empire State Corporation	1037003	MTB	The PNC Financial Services Group, Inc.	1069778	PNC
First Financial Bancorp.	1071276	FFBC	TIB Financial Corp.	2457943	TIBB
First Financial Corporation	1208595	THFF	U.S. Bancorp.	1119794	USB
First Horizon National Corporation	1094640	FHN	UnionBancorp, Inc.	1206591	TRUE
First Midwest Bancorp, Inc.	1208184	FMBI	United Bancorp, Inc.	1071502	UBCP
FirstMerit Corporation	1070804	FMER	United Bancshares, Inc.	1136009	UBOH
FNB Corp.	1133473	FNBN	United Bankshares, Inc.	1076217	UBSI
Franklin Resources, Inc.	1246216	BEN	W Holding Company Incorporated	2801546	WHI
Fulton Financial Corporation	1117129	FULT	Wintrust Financial Corporation	2260406	WTFC
German American Bancorp	1098620	GABC	Zions Bancorporation	1027004	ZION

Appendix A

Panel B: Non-Securitisers

BHC name	RSSD ID	Ticker	BHC name	RSSD ID	Ticker
1st Constitution Bancorp.	2784920	FCCY	Carrollton Bancorp.	1469800	CRRB
ABC Bancorp	1082067	ABCB	Cascade Bancorp.	1848003	CACB
Access National Corp.	3109904	ANCX	Cascade Financial Corp.	2568362	CASB
Alliance Bankshares Corp.	3123638	ABVA	Cass Information Systems, Inc.	1098648	CASS
Alliance Financial Corp.	1140510	ALNC	Cathay General Bancorp, Inc.	1843080	CATY
American National Bankshares Inc.	1076691	AMNB	Center Bancorp, Inc.	1048764	CNBC
American River Bankshares	2312837	AMRB	Center Financial Corp.	3003178	CLFC
AmeriServ Financial, Inc.	1117316	ASRV	Centerstate Banks of Florida, Inc.	2868129	CSFL
Annapolis Bancorp, Inc.	1472257	ANNB	Central Virginia Bankshares, Inc.	1140677	CVBK
Banc Corp.	2731858	SUPR	Century Bancorp, Inc.	1111088	CNBKA
BancFirst Corp.	1133286	BANF	Chemical Financial Corp.	1201934	CHFC
Bancorp Rhode Island, Inc.	2896458	BARI	Citizens Banking Corp.	1205688	CRBC
BancorpSouth, Inc.	1097614	BXS	Citizens Holding Company	1083475	CIZN
Bancshares of Florida, Inc.	2796624	BOFL	City National Corp.	1027518	CYN
Bank of Commerce Holdings	1030040	BOCH	CNB Financial Corp.	1118340	CCNE
Bank of Granite Corp.	1143481	GRAN	CoBiz Inc.	1060328	COBZ
Bank of Hawaii Corp.	1025309	BOH	Codorus Valley Bancorp, Inc.	1142475	CVLY
Bank of South Carolina Corp.	2297701	BKSC	Colony Bankcorp, Inc.	1085170	CBAN
Bank of the Ozarks, Inc.	1097089	OZRK	Columbia Bancorp.	2378440	CBBO
Banner Corp.	2126977	BANR	Columbia Banking System, Inc.	2078816	COLB
Bar Harbor Bankshares	1115385	BHB	Comerica Incorporated	1199844	CMA
BB&T Corp.	1074156	BBT	Commerce Bancshares, Inc.	1049341	CBSH
Berkshire Bancorp, Inc.	2728157	BERK	Commercial Bancorp.	1029893	WCBO
BNC Bancorp.	3141650	BNCN	Commercial National Financial Corp.	1823738	CNAF
Boston Private Bancorp, Inc.	1248078	BPFH	Commonwealth Bankshares, Inc.	1250606	CWBS
Bridge Capital Holdings	3280988	BBNK	Community Bank Shares of Indiana, Inc.	2356073	CBIN
Britton & Koontz Capital Corp.	1084212	BKBK	Community Bank System, Inc.	1048867	CBU
Bryn Mawr Bank Corp.	1140994	BMTC	Community Capital Corp.	1398937	CPBK
C&F Financial Corp.	2183493	CFFI	Community Central Bank Corp.	2443526	CCBD
Camco Financial Group	1251256	CAFI	Community Trust Bancorp, Inc.	1070644	CTBI
Capital Bank Corp.	2741156	CBKN	Community West Bancshares	2626299	CWBC
Capital City Bank Group, Inc.	1085509	CCBG	Cowlitz Bancorp.	1984040	CWLZ
Cardinal Financial Corp.	2682996	CFNL	CPB Inc.	1022764	CPF
Carolina Bank Holdings, Inc.	2943473	CLBH	Crescent Banking Company	1958827	CSNT

Appendix A

Panel B: Non-Securitisers (CONT'D)

BHC name	RSSD ID	Ticker	BHC name	RSSD ID	Ticker
Crescent Financial Corp.	3027709	CRFN	Greene County Bancshares, Inc.	1133277	GRNB
Cullen&Frost Bankers, Inc.	1102367	CFR	Hancock Holding Company	1086533	HBHC
CVB Financial Corp.	1029222	CVBF	Hanmi Financial Corp.	2900261	HAFC
Dearborn Bancorp, Inc.	2193906	DEAR	Harleysville National Corp.	1117192	HNBC
Eastern Virginia Bankshares, Inc.	2626691	EVBS	Harleysville Savings Financial Corp.	2861492	HARL
ECB Bancorp, Inc.	2686659	ECBE	Heartland Financial USA, Inc.	1206546	HTLF
EuroBancshares, Inc.	3106864	EUBK	Heritage Commerce Corp.	2634874	HTBK
Evans Bancorp, Inc.	1401190	EVBN	Heritage Financial Corp.	2166124	HFWA
F.N.B. Corp.	3005332	FNB	Heritage Oaks Bancorp.	2253529	HEOP
Farmers Capital Bank Corp.	1098732	FFKT	Home Federal Bancorp.	3059504	INCB
Fauquier Bankshares, Inc.	1076600	FBSS	Horizon Bancorp.	1209136	HBNC
Fidelity Southern Corp.	1081118	LION	Hudson City Bancorp, Inc.	2792680	HCBK
Financial Institutions, Inc.	1032464	FISI	Independent Bank Corp.	1136803	INDB
First Bancorp.	1076431	FBNC	Independent Community Bancshares, Inc.	2176413	MBRG
First Citizens Banc Corp.	1246533	FCZA	Integra Bank Corp.	1132654	IBNK
First Commonwealth Financial Corp.	1071306	FCF	Intervest Bancshares Corp.	2049302	IBCA
First Community Bancorp.	2875332	PACW	ISB Financial Corp.	2291914	IBKC
First Community Corp.	2337401	FCCO	Jacksonville Bancorp, Inc.	2737766	JAXB
First Financial Bankshares, Inc.	1102312	FFIN	Jeffersonville Bancorp.	1048504	JFBC
First Financial Service Corp.	3150997	FFKY	Lakeland Bancorp, Inc.	1404799	LBAI
First M & F Corp.	1095982	FMFC	Lakeland Financial Corp.	1208906	LKFN
First Mariner Bancorp.	2322304	FMAR	Landmark Bancorp, Inc.	3030307	LARK
First Merchants Corp.	1208559	FRME	Leesport Financial Corp.	1136139	VIST
First National Lincoln Corp.	1133932	FNLC	LSB Bancshares, Inc.	1076002	NBBC
First Regional Bancorp.	1029428	FRGB	Macatawa Bank Corp.	2634696	MCBC
First State BanCorp.	1364071	FSNM	MBT Financial Corp.	2907822	MBTF
First United Corp.	1132672	FUNC	Mercantile Bank Corp.	2608763	MBWM
First West Virginia Bancorp, Inc.	1070336	FWV	Merchants Bancshares, Inc.	1023239	MBVT
Firstbank Corp.	1134322	FBMI	MetLife, Inc.	2945824	MET
Friedman, Billings, Ramsey Group, Inc.	2926636	FBR	MetroCorp Bancshares, Inc.	2344799	MCBI
Frontier Financial Corp.	1031346	FTBK	MidSouth Bancorp, Inc.	1086654	MSL
Glacier Bancorp, Inc.	2003975	GBCI	Midwest Banc Holdings, Inc.	1209828	MBHI
Glen Burnie Bancorp.	2001328	GLBZ	Monmouth Community Bancorp.	2910055	CJBK
Great Southern Bancorp, Inc.	2339133	GSBC	Nara Bancorp, Inc.	2961879	NARA

Appendix A

Panel B: Non-Securitisers (CONT'D)

BHC name	RSSD ID	Ticker	BHC name	RSSD ID	Ticker
National Bankshares, Inc.	1139925	NKSH	Princeton National Bancorp, Inc.	1207600	PNBC
National Penn Bancshares, Inc.	1117026	NPBC	PrivateBancorp, Inc.	1839319	PVTB
NB&T Financial Group, Inc.	1070756	NBTF	Prosperity Bancshares, Inc.	1109599	PRSP
NBC Capital Corp.	1100037	CADE	Provident Financial Services, Inc.	3133637	PFS
NBT Bancorp Inc.	1139279	NBTB	Quad City Holdings, Inc.	2125813	QCRH
New York Community Bancorp, Inc.	2132932	NYB	Republic First Bancorp, Inc.	1398807	FRBK
NewSouth Bancorp, Inc.	2521509	FSBK	Corus Bankshares, Inc.	1200393	CORS
North Country Financial Corp.	1123933	MFNC	Royal Bancshares of Pennsylvania, Inc.	2324429	RBPAA
North Valley Bancorp.	1029334	NOVB	Rurban Financial Corp.	1071454	RBNF
Northern Trust Corp.	1199611	NTRS	S&T Bancorp, Inc.	1071397	STBA
Norwood Financial Corp.	2365356	NWFL	Salisbury Bancorp, Inc.	2693273	SAL
Ohio Legacy Corp.	2873039	OLCB	Sandy Spring Bancorp, Inc.	1248304	SASR
Ohio Valley Banc Corp.	2012436	OVBC	Savannah Bancorp, Inc.	1493560	SAVB
Old National Bancorp.	1098303	ONB	SCBT Financial Corp.	1133437	SCBT
Old Point Financial Corp.	1076673	OPOF	Seacoast Banking Corp. of Florida	1085013	SBCF
Old Second Bancorp, Inc.	1206911	OSBC	Shore Bancshares, Inc.	2429838	SHBI
OptimumBank Holdings, Inc.	3251661	OPHC	Sierra Bancorp.	2976396	BSRR
Oriental Financial Group Inc.	2490575	OFG	Silicon Valley Bancshares	1031449	SIVB
PAB Bankshares, Inc.	1083934	PABK	Simmons First National Corp.	1094828	SFNC
Pacific Continental Corp.	2762973	PCBK	Smithtown Bancorp, Incorporated	1048997	SMTB
Pacific Mercantile Bancorp.	2869733	PMBC	Somerset Hills Bancorp.	2950480	SOMH
Park National Corp.	1142336	PRK	South Alabama Bancorp.	1138012	BTFG
Parke Bancorp.	3347292	PKBK	Southern Community Financial Corp.	2981831	SCMF
Patriot National Bancorp, Inc.	2840479	PNBK	Southern Missouri Bancorp, Inc.	3266227	SMBC
Peapack-Gladstone Financial Corp.	2651590	PGC	Southside Bancshares, Inc.	1245068	SBSI
Penns Woods Bancorp, Inc.	1117688	PWOD	Southwest Bancorp, Inc.	1062621	OKSB
Pennsylvania Commerce Bancorp, Inc.	2807614	COBH	Southwest Georgia Financial Corp.	1081538	SGB
Peoples Bancorp of North Carolina, Inc.	2818245	PEBK	State Bancorp, Inc.	1138861	STBC
Peoples Bancorp, Inc.	1070578	PEBO	Sterling Bancorp.	1039454	STL
Peoples Financial Corp.	1133174	PFBX	Sterling Bancshares, Inc.	1105425	SBIB
Peoples Holding Company	1098844	RNST	Suffolk Bancorp.	1130865	SUBK
Pinnacle Financial Partners, Inc.	2925657	PNFP	Sun Bancorp, Inc.	1139242	SNBC
Premier Financial Bancorp, Inc.	2007647	PFBI	Sussex Bancorp.	2461463	SBBX
PremierWest Bancorp.	2867542	PRWT	Synovus Financial Corp.	1078846	SNV

Appendix A

Panel B: Non-Securitisers (CONT'D)

BHC name	RSSD ID	Ticker	BHC name	RSSD ID	Ticker
Taylor Capital Group, Inc.	2495039	TAYC	United Security Bancshares, Inc.	1086168	USBI
TCF Financial Corp.	2389941	TCB	Univest Corp. of Pennsylvania	1116609	UVSP
Texas Capital Bancshares, Inc.	2706735	TCBI	Valley National Bancorp.	1048773	VLY
The First of Long Island Corp.	1048894	FLIC	Village Bank and Trust Financial Corp.	3251027	VBFC
The Wilber Corp.	1048670	GIW	Virginia Commerce Bancorp, Inc.	2856377	VCBI
Tompkins Trustco, Inc.	2367921	TMP	Virginia Financial Group, Inc.	2502049	STEL
Tower Financial Corp.	2745604	TOFC	Waccamaw Bankshares, Inc.	3004689	WBNK
TriCo Bancshares	1030170	TCBK	Washington Banking Company	2406174	WBCO
TrustCo Bank Corp of NY	1048513	TRST	Washington Trust Bancorp, Inc.	1115349	WASH
Trustmark Corp.	1079562	TRMK	Webster Financial Corp.	1145476	WBS
Umpqua Holdings Corp.	2747644	UMPQ	WesBanco, Inc.	1070448	WSBC
Union Bankshares Corp.	1971693	UBSH	West Bancorporation, Inc.	1210066	WTBA
Union Bankshares, Inc.	1114940	UNB	Westamerica Bancorp.	1025541	WABC
Union Financial Bancshares, Inc.	3177341	PCBS	Whitney Holding Corp.	1079740	WTNY
United Community Banks, Inc.	1249347	UCBI	Wilmington Trust Corp.	1888193	WL
United Missouri Bancshares, Inc.	1049828	UMBF	Wilshire Bancorp, Inc.	3248513	WIBC
United Security Bancorp.	1031627	AWBC	WVS Financial Corp.	2140115	WVFC
United Security Bancshares	3015975	UBFO			

Appendix B

Variable names and definitions

Variable		**FR-Y9C Form data item**
Capital Adequacy		
CAP	Capital ratio	BHCK3210/BHCK2170
Asset Quality		
GAP	1Y maturity gap	abs[(BHCK3197 – (BHCK3296 + BHCK3298))/(BHCK2170 – (BHCK2145 + BHCK2150 + BHCK2130 + BHCK3163 + BHCK0426))]
LATA	Liquid assets to total assets	(BHCK0010 + BHDMB987 + BHCKB989 + BHCK1754 + BHCK1773) / BHCK2170
H_LOAN	Loan Herfindahl index	$(TCI+UCI)^2 + REL^2 + AGL^2 + CLR^2 + TOL^2$
TCI	Total C&I loans ratio	(BHCK1763 + BHCK1764) / (BHCK2122 + BHCK2123)
UCI	US C&I loans ratio	BHCK1763 / (BHCK2122 + BHCK2123)
REL	Loans secured by real estate	BHCK1410 / (BHCK2122 + BHCK2123)
AGL	Agriculture loans	BHCK1590 / (BHCK2122 + BHCK2123)
CLR	Consumer loans	(BHCKB538 + BHCKB539 + BHCK2011) / (BHCK2122 + BHCK2123)
TOL	Total other loans	[BHCK2122 - (BHCK1410 + BHCK1590 + BHCK1763 + BHCK1764 + BHCK1296 + BHCK2081 + BHCKB538 + BHCKB539 + BHCK2011)] / (BHCK2122 + BHCK2123)
NPL	Non-performing loans	(BHCK5526 + BHCK5525 - BHCK3507 - BHCK3506) / BHCK2122
Earnings, Efficiency & Profitability		
ROA	Return on assets	BHCK4340/BHCK2170
ROID	Revenue diversification	1-|(BHCK4107 - BHCK4079)/(BHCK4107 + BHCK4079)|
H_NOIR	Non-interest income diversification (8 parts)	(BHCK4070/BHCK4079) + (BHCK4483/BHCK4079) + (BHCKA220/BHCK4079) + (BHCKB490/BHCK4079) + (BHCKB491/BHCK4079) + (BHCKB492/BHCK4079) + (BHCKB493/BHCK4079) + (BHCKB494/BHCK4079)
H_NITR	Interest income diversification (12 parts)	(BHCK4435/BHCK4107) + (BHCK4436/BHCK4107) + (BHCKF821/BHCK4107) + (BHCK4059/BHCK4107) + (BHCK4065/BHCK4107) + (BHCK4115/BHCK4107) + (BHCKB488/BHCK4107) + (BHCKB489/BHCK4107) + (BHCK4060/BHCK4107) + (BHCK4069/BHCK4107) + (BHCK4020/BHCK4107) + (BHCK4518/BHCK4107)
Off - Balance Sheet Activities		
TSEC	Outstanding principal value of assets securitized	(BHCKB705 + BHCKB706 + BHCKB707 + BHCKB708 + BHCKB709 + BHCKB710 + BHCKB711) / BHCK2170
RSEC	1-4 family residential securitization	BHCKB705/BHCK2170
HSEC	Home equity lines securitization	BHCKB706/BHCK2170
CRSEC	Credit cards receivable securitization	BHCKB707/BHCK2170
ASEC	Auto loans securitization	BHCKB708/BHCK2170
CSEC	Other consumer loans securitization	BHCKB709/BHCK2170
CISEC	C&I loans securitization	BHCKB710/BHCK2170
AOSEC	All other loans, leases, and other assest securitization	BHCKB711/BHCK2170
LT_SEC	Long-term assets securitized	**RSEC**
MT_SEC	Medium-term assets securitized	**HSEC + CISEC**
ST_SEC	Short-term assets securitized	**CRSEC + ASEC + CSEC + AOSEC**
NECP	Net credit protection (Bought-Sold)	[(BHCKC969 + BHCKC971 + BHCKC973 +BHCKC975) - (BHCKC968 + BHCKC970 + BHCKC972 +BHCKC974)] / BHCK2170