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How Smart are Investors after the Subprime Mortgage Crisis?
Evidence from the Securitization Market

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Abstract

Two factors have proven to be strongly relevant for the subprime mortgage crisis. The first is the lack of screening incentives of originators, which had not been anticipated by investors. The second is that investors relied too much on credit ratings. We examine whether investors have learned from these shortcomings. On the basis of securitizations from 2010 and 2011, we find that investors require a significantly higher risk premium when there is a high degree of asymmetric information. The credit spreads of information sensitive tranches are significantly higher if originators do not retain a part of the securitization or if they choose vertical slice retention instead of retaining the equity tranche. Moreover, the relevance of credit ratings in comparison to other credit factors has significantly decreased. Apparently, investors mainly consider ratings to discriminate between information sensitive and information insensitive tranches, beyond that they rely on their own risk analysis. This suggests that investors have learned their lesson from the subprime mortgage crisis.

Keywords: security design, asset-backed securities, retention, credit spread

JEL classification: G21, G24, G28

1 Introduction

There is a growing body of literature that analyzes the causes of the subprime crisis.¹ An important contribution to the crisis was the originate-to-distribute (OTD) model. If originators know that they can sell loans through securitizations without participating in later defaults, they might only apply lax screening. However, low screening incentives have not been anticipated by investors. Moreover, there was an overreliance of investors on credit ratings which led to a collective mispricing, particularly for AAA tranches. Broadly speaking, the pre-crisis period can be characterized as investors acting too naïve.

However, investors probably learned from some of these shortcomings, which leads to our *smart investors hypothesis*. If this hypothesis is true, investors should have intensified their own risk analysis instead of relying on ratings. Moreover, they should anticipate low screening incentives implying originators to bear the costs of asymmetric information. Against this background, our main research question is: Have investors learned their lesson from the subprime mortgage crisis?

The relevance of asymmetric information in securitizations has been extensively discussed in the literature. In theoretical models, it has been shown that pooling, tranching, and retention are important features to reduce costs of asymmetric information. If the market consists of informed and uninformed traders, there are benefits of pooling loans before originators sell them since this leads to a reduction of the adverse selection problem of uninformed traders (Subrahmanyam, 1991; Gorton/Pennachi, 1993). However, there is an information destruction effect of pooling since the informational advantage of informed investors diminishes. Against this background, it can be beneficial to split the pooled loans in information sensitive and insensitive tranches. Thus, informed investors can still profit from their informational advantage and remain in the market (Boot/Thakor, 1992). However, it is not only important to consider

¹ Recent examples are Brunnermeier (2009), Purnanandam (2011), Demyanyk/van Hemert (2011), and Männmann (2012).

asymmetric information between investors but also private information of the originator about the quality of the loans. Focusing on asymmetric information between originators and investors, it can be beneficial for originators to signal a high quality of pooled assets by retaining a portion of the issue, the equity tranche (DeMarzo/Duffie, 1999). The above mentioned information destruction effect of pooling is nevertheless a problem, so that in this setting it can be beneficial to sell assets separately instead of pooling them in order to attract informed investors, too. However, there is also a risk diversification effect of pooling, which allows to issue a highly information insensitive tranche. Due to this effect, a combination of pooling and tranching can indeed be optimal when originators retain the information sensitive tranche (DeMarzo, 2005). Within a dynamic setting, retaining the equity tranche has been shown to be a close approximation of the optimal security design (Hartmann-Glaser, 2012).

There also exists literature that does not solve for the optimal design of securitizations but focuses on the benefits of different types of retention. Comparing retention of the equity tranche, the mezzanine tranche, and vertical slice retention, which is an equally weighted retention of each issued tranche, the screening effort is generally maximized if originators retain the equity tranche. Only if the probability of downturn is high (implying the equity tranche to likely default) and if the mezzanine tranche or vertical slices are quite thick, these types of retention can dominate the equity retention (Fender/Mitchell, 2010).

Despite the theoretical arguments regarding reduced screening incentives (see also Pennacchi, 1988; Parlour/Plantin, 2008), many originators practiced the OTD model without retaining a significant share in the pre-crisis period. However, investors did hardly consider the reduced incentives in the pricing of securitizations although there is strong empirical evidence from the pre-crisis period that the OTD model indeed led to lax screening of subprime mortgage loans (Keys et al., 2010) and to the origination of low quality loans (Purnanandam, 2011). These findings are particularly valid for originators which have performed poorly be-

fore origination because reputational concerns are hardly taken into account by them (Titman/Tsyplakov, 2010).

In addition to these findings regarding screening incentives, there is evidence that many investors relied too much on ratings in the pre-crisis period, which might be due to a lack of transparency of the securitization process (Pagano/Volpin, forthcoming). Even if there is also some empirical evidence that investors did not completely outsource their risk analysis to rating agencies, results for AAA tranches, which represent the major share of all tranches, confirm the rating overreliance hypothesis in the years before the subprime mortgage crisis (Mählmann, 2012; Adelino, 2009). Moreover, even for non-AAA tranches credit spreads of asset-backed securities can be substantially explained by credit ratings (Fabozzi/Vink, forthcoming). Consistent to these results, it has been shown for the period 2004–2007 that there was a mispricing of highly-rated tranches since their highly systemic nature of risk had not been considered. This is arguably a result of investors relying too much on ratings although ratings do not reflect the systematic nature of risk but the probability of default or the expected loss (Coval, 2009b).

In order to test whether investors have learned from their shortcomings prior to the subprime mortgage crisis, we analyze how strong their reliance on credit ratings is and whether they consider asymmetric information in their pricing of securitizations in a period after the subprime mortgage crisis. If our *smart investors hypothesis* is valid, we expect the following:

- a) Investors anticipate low screening incentives, so that originators have to bear the costs of asymmetric information. Thus, for information sensitive tranches we hypothesize that retention of the equity tranche leads to significantly lower credit spreads than if originators retain no material share of the securitization. Furthermore, the credit spread should be lower for equity retention than for vertical slice retention, since equity retention maximizes the screening effort. For information insensitive tranches, either the equity retention or the vertical slice retention should cause a lower credit spread due to the dependence on

downturn scenarios of these tranches. However, the impact of asymmetric information should be rather low.

- b) Investors should have intensified their own risk analysis instead of relying on ratings. The impact of credit ratings on credit spreads should be lower than in the pre-crisis period. The relevance of additional credit factors should have increased.

Based on securitizations from 2010 and 2011, we find strong support for our *smart investors hypothesis*. Our results show that investors clearly consider asymmetric information in pricing securitizations. For information sensitive tranches, where screening incentives have the greatest impact, we find that investors require an additional risk premium of more than 100 basis points (bp) compared to the case of equity retention if originators do not retain a material share of securitizations. Similarly, vertical slice retention also leads to a significantly higher risk premium compared to equity retention. If we consider only the very information insensitive AAA tranches, we find that the spread difference due to the type of retention is materially lower with at maximum 30bp. Moreover, vertical slice retention causes a lower risk premium than equity retention. This result is economically plausible: The value of AAA tranches depends heavily on the probability of economic downturns since only in these scenarios AAA tranches are likely to default (Coval, 2009a, b). However, in an economic downturn, the equity tranche is very likely to default so that there is no incentive of monitoring the loans if the equity tranche has been retained. On the contrary, retaining a vertical slice maintains incentives for originators even in downturn scenarios.

We also find strong evidence that investors have intensified their own risk analysis. Contrasting our results to those of pre-crisis periods, we find that the influence of credit ratings on credit spreads has clearly decreased while the influence of additional credit factors has considerably increased. Considering only non-AAA tranches, we observe that the relevance of credit ratings is even lower whereas the importance of additional credit factors is substantial.

Our results suggest that investors mainly consider ratings to separate AAA from non-AAA tranches. After this separation, investors rely on their own risk analyses.

This study makes the following contributions: First, to our knowledge, this is the first study which uses the retention of securitizations to measure asymmetric information concerning the issued tranches. Second, our results suggest that investors anticipate screening incentives of originators and choose the required risk premium on the basis of the degree of asymmetric information. Third, the relevance of investors' own risk analyses has substantially increased after the subprime mortgage crisis whereas ratings are mainly used to separate information sensitive from information insensitive tranches. Thus, regarding the considered shortcomings in the pre-crisis period, there is strong evidence that investors have learned their lesson.

The paper proceeds as follows. In Section 2, we describe our data set. Section 3 presents the empirical results on the influence of credit ratings and information asymmetries on the risk premium of securitizations. Section 4 concludes.

2 Data

Subsequently, we first describe the sample and the criteria for exclusion of data. Then, we explain the measurement of relevant variables including regulatory retention rules. Finally, we present summary statistics of our data set.

2.1 Sample selection

The data considered in this study rely on two sources. First, DZ Bank delivered data on European securitizations. These data are consolidated from Bloomberg, the rating agencies Standard & Poors, Moody's, and Fitch, as well as ABS data providers. Second, for one of our main variables, the type of retention, we use hand-collected data from the respective prospectuses that stem from ABS data providers and Bloomberg. The data set contains virtually the entire universe of European ABS, MBS, and CDO securitizations issued in 2010 and 2011. One advantage of using these data is the visibility of the influence of minimum retention re-

quirements of the European Union, which have come into effect on January 1st 2011. As a consequence, the data from 2010 contain a significant share of contracts with no relevant amount of retention (or at least a potential retention is not apparent for the investors). However, issues after January 1st 2011 mostly include one of the allowed types of retention. Another advantage is that due to the regulatory rules, the retention is usually clearly reported in the prospectus and the respective data are more consistent leading to high data quality.

This initial data set consists of 1138 tranches from 370 deals. From this sample we exclude all CDO deals since these are actively managed and therefore the interest rate reflects not only the risk of the underlying assets but also the ability of the CDO manager in selecting undervalued tranches. Furthermore, we exclude all fixed rate tranches and all tranches where the prospectus is not available so that important data are missing. Additionally, we do not consider tranches without a credit rating. This can be the case if the rating agencies have no mandate for the deal, but in most cases these tranches are equity tranches. There are two reasons for excluding these observations. First, for our analyses of the reliance on ratings these tranches are obviously unsuitable. Second, if the equity tranche is retained partly or completely, the credit spread hardly contains information about the required return of investors. After this data cleaning, we have a final sample of 584 tranches from 237 deals, with 240 tranche observations from 2010 and 344 observations from 2011. The total nominal value of these tranches is €485.7 billion.

2.2 Variable measurement

2.2.1 Tranche level and deal level variables

On tranche level, we extract information on risk premium, credit rating, credit enhancements, liquidity, and maturity. The risk premium is measured as the credit spread at origination. One reason is the difficulty in obtaining reliable secondary market spreads, another rea-

son is the particular relevance of the issuance spread from the originators perspective. The credit rating is obtained from S&P, Moody's, and Fitch ratings. These ratings are converted to a point scale where an increase of 1 point reflects a rating which is one notch worse. In most cases, there is more than one rating so that the average rating is computed from the point scales. On the basis of this average rating, we determine the rating letter (AAA, AA, ..., CCC), which is relevant for our empirical analyses. The ratings letters are considered as dummy variables. As a measure for the credit enhancement, we use the subordination level of each tranche. Consistent to Fabozzi/Vink (forthcoming), this level is computed as the percentage of total liabilities that is subordinate to the tranche. Our proxy for the liquidity of a tranche is its nominal value in Euro, or more precisely the natural logarithm of this value. Maturity is measured as the weighted average life (WAL) of the tranche, which is reported in the prospectus.

On deal level, we use information about deal complexity, segment, asset class, country, and type of retention. We use the number of tranches as a proxy variable for the deal complexity. The segmentation variable has two possible values, indicating asset-backed securities (ABS) or mortgage-backed securities (MBS). The asset class is a more detailed classification. For ABS, we have the asset classes Auto ABS, Consumer ABS, Credit Card ABS, Lease ABS, and Other ABS. The segment MBS can be divided into residential MBS (RMBS), commercial MBS (CMBS), and deals with a mix of both assets (Mix MBS). The country variable is the country of collateral, i.e. the country where the main part of the underlying collateral is located, and not the country of origination. This is due to the fact that the quality of the security should mainly be reflected by characteristics of the underlying assets and not of the originator. One of our most important variables is the type of retention, which is described in the following section.

2.2.2 *Retention*

As noted above, the information about the retention is directly extracted from the prospectuses. Our retention variable is not a binary variable which only indicates whether the originator retains a part of the transaction or not. Instead, we collect data about the concrete type of retention, e.g. equity or vertical slice retention. Since the retention data are heavily influenced by regulatory rules, we briefly present the retention rules subsequently. The rationale behind the discussion to establish retention rules is to “provide a sponsor with an incentive to monitor and control the quality of the assets being securitized and help align the interests of the sponsor with those of investors in the ABS” (SEC 2012),² and is thus in line with the theoretical literature. However, this does not mean that the literature implies the necessity of regulatory rules since it is possible that originators voluntarily choose retention as a consequence of smart investors who anticipate differing interests.

The minimum retention requirements of the European Union are formulated in Article 122a of the Capital Requirements Directive (CRD) and have come into effect on January 1st 2011. Due to these rules, a credit institution is only allowed to invest into a securitization position if the originator (or sponsor or original lender) has disclosed that he will retain a material net economic interest of at least 5%. Thus, the regulatory rules do not imply that European originators have to retain a material net economic interest but ignoring these requirements means that European credit institutions are not allowed to invest in these securities. Consequently, these rules are also relevant for originators outside the European Union.

There are 4 permitted types of retention:

- a) Equity: Retention of the first loss tranche and, if necessary to achieve at least 5% retention of the nominal value on an ongoing basis, other consecutive tranches.
- b) Vertical slice: Retention of at least 5% of every single tranche that is sold to investors.

² This argument is mentioned in the regulatory US and European documents.

- c) Seller's share: Retention of at least 5% of the nominal value of the pooled revolving assets. This option is mainly relevant for revolving master trust structures.
- d) Random selection: Retention of at least 5% of the nominal amount on the basis of randomly selected assets that would otherwise have been securitized in the securitization. This option is only allowed if the potential securitization consists of at least 100 assets at origination.

It is also worth mentioning that in March 2011 there have been regulatory proposals for similar rules in the United States. Here an additional type of retention is discussed: the L-shaped risk retention. This is a combination of equity retention (horizontal component) of at least 2.5% and vertical slice retention (vertical component) of at least 2.564%.

In most cases, information about the retention can be found in the prospectus with the following key words: retain, retention, subordinated loan, and 122a CRD. For Spanish prospectuses, we mainly use the key words *retendrá*, *retención*, *préstamo subordinado*, and *Real Decreto 771/2011*. The strings "122a CRD" and "Real Decreto 771/2011" are of course only relevant for the data after the regulatory rules have come into effect. Based on these data, we generate a variable with the type of retention. To have consistent data in 2010 and 2011, we assume that only if the retention is at least 5%, there is a material net economic interest. If the retention is less than 5% or if there is no information about retention in the prospectus, we assign the category "no qualified retention".

2.3 Descriptive statistics

Summary statistics of our sample are presented in Tables 1, 2, and 3. To provide some insights into the composition of the data, we show the distribution across years, credit ratings, asset classes, and country of collateral in Table 1. We find that AAA tranches are the predominant rating category. Furthermore, almost all MBS tranches come from residential and not commercial MBS. Moreover, the most active securitization markets in Europe (concerning the

underlying collateral) are the United Kingdom and the Netherlands, each with a share of more than 30% of the total number of observations. In Table 2, we present details about the distribution of several credit factors: credit spread, subordination level, volume, number of tranches, and weighted average life. There is a wide range of credit spreads from 5bp to 950bp, with typical values around 150bp. The distribution of the volume of tranches is highly right-skewed with a median of €409.5 million, a mean of €830 million, and a maximum of €47,000 million. Furthermore, a typical deal has between 3 and 6 tranches; however, there are some very simple deals with only one rated tranche and also highly complex deals with up to 19 tranches. Finally, summary statistics regarding the type of retention can be found in Table 3. We find that all regulatory allowed types of retention are actively used in securitizations. However, most originators choose the retention type equity or seller's share. There is also a high number of tranches without qualified retention (168 observations). As expected, most of these observations are issued in 2010, meaning that originators chose for 61.67% of these tranches not to retain a material net economic interest.

[Table 1]

[Table 2]

[Table 3]

3 Empirical Results

Subsequently, we first analyze the degree of rating reliance in section 3.1. Building on the results of this section, we examine the influence of asymmetric information on credit spreads in section 3.2.

3.1 How strong is the reliance on credit ratings?

In order to analyze the degree of credit rating reliance, we first consider the impact of several credit factors in explaining the observed credit spreads. Then, we split the sample into

“non-AAA” and “AAA only” tranches to examine whether there is a difference between information sensitive and information insensitive tranches. Finally, we consider the relevance of credit ratings for the credit spread within the framework of the full sample and the information sensitive tranches.

Our first set of regressions is based on the following specification:

$$\text{spread}_{it} = \alpha + \gamma' \cdot \text{credit factors}_i + \chi' \cdot \text{controls}_i + \lambda_t + \varepsilon_{it}, \quad (1)$$

where the credit factors and the control variables are included in Table 2 and Table 1, respectively. Furthermore, λ_t contains quarter fixed effects. The results are presented in Table 4. We present three models that differ in following respects. The difference between model (1.A) and (1.B) is the inclusion of fixed effects for the country of collateral, in model (1.C), we additionally include asset class fixed effects. The main results are consistent to the theoretical arguments. A high subordination level leads to significantly decreased credit spread. Furthermore, a high liquidity, represented by the (logarithm of the) nominal value, causes an additional decrease in credit spreads. Both effects are highly economically relevant. Moreover, an increasing deal complexity, represented by the number of tranches, is connected with a higher credit spread. However, this effect is only significant in some of the models. The impact of WAL is rather low. Altogether, these credit factors can explain a material part of the credit spread. Additionally, the country of collateral has a relevant effect on the credit spread whereas the influence of the asset class is rather low. An adjusted R^2 of 45% in model (1.C) indicates that a high share of the credit spread variation can be explained by credit factors. For comparison, the adjusted R^2 of similar credit factors in the pre-crisis period 1999-2007 is at maximum 15% (Fabozzi/Vink, forthcoming). Thus, we find that the relevance of credit factors has remarkably increased.

[Table 4]

Next, we split the sample into non-AAA and AAA tranches (see Table 5). For non-AAA tranches (models (1.D)-(1.F)), we can confirm all full sample results. Actually, the economic relevance of the credit factors is even remarkably higher than for the full sample. Furthermore, the coefficient of the number of tranches does not only have the correct sign but is highly significant. Remarkably, if we consider only AAA tranches (models (1.G)-(1.I)), none of these credit factors is important for the credit spread. However, the country of collateral as well as the asset class has a high impact on the required risk premium although the rating of all of these tranches is identical. Even if we do not observe which criteria lead to the different assessment of quality among countries and asset classes, it is a clear indicator that investors acquire information beyond credit ratings.

[Table 5]

Finally, we analyze the impact of credit ratings on credit spreads for the full sample and for non-AAA tranches using the following specification:

$$\text{spread}_{it} = \alpha + \gamma' \cdot \text{credit factors}_i + \delta' \cdot \text{credit rating}_i + \chi' \cdot \text{controls}_i + \lambda_i + \varepsilon_{it}. \quad (2)$$

Our base category for credit ratings is AAA for the full sample analysis and AA for the non-AAA analysis (Table 6). Within the framework of model (2.A) we only consider credit rating, i.e. $\gamma' = 0$, while model (2.B) additionally includes credit factors. At a first sight, we find that credit ratings are mostly highly significant and can explain a notable part of the credit spread variation on the full sample, with an adjusted R^2 of 33.1%. Inclusion of the additional credit factors increases this value to 53.5%. In contrast, in the pre-crisis period 1999-2007 credit ratings lead to an adjusted R^2 of 69% and inclusion of additional risk factors can only slightly increase this value to 71% (see Fabozzi/Vink, forthcoming). This shows that the reliance on credit ratings is significantly lower after the subprime crisis. Analyzing the regression results in more detail, we find several additional indications that the reliance on credit ratings is ra-

ther low. First, in model (2.A) the credit spreads are not at all monotonously increasing with lower ratings. If we additionally consider our credit factors (model 2), the coefficients of the rating dummies are economically much more plausible. Furthermore, on the basis of the non-AAA sample in model (2.C) we find that the coefficients of credit ratings are largely not significant or economically implausible. Moreover, the low adjusted R^2 of 10.5% suggests that there are additional factors which are considered by investors. This supposition is shown to be true in model (2.D) since the variation of credit spreads can largely be explained by additional credit factors. We find that the significance and magnitude of the coefficients is partially lower than without considering credit ratings but all coefficients have the same sign (cf. Table 5, model (1.F)). This suggests that these variables have already been considered in credit ratings but investors attribute greater importance to these credit factors. Finally, in this last model, the rating coefficients are economically most plausible since the coefficients are monotonically increasing with the only exception being the CCC rating, which consists of only 4 observations.

[Table 6]

Summing up, we find strong evidence that the reliance of investors on credit ratings is rather low. Particularly, the reliance has significantly decreased after the subprime mortgage crisis. The influence of additional credit factors, on the other hand, has significantly increased. This finding is consistent with our *smart investor hypothesis*.

There is another interesting implication of our results: As discussed above, the influence of credit ratings on the full sample is substantial higher than on the sub-sample of non-AAA tranches. We interpret this as follows. From an investors perspective, rating information on securitizations is mainly used for differentiating between information sensitive and information insensitive tranches. Depending on the risk appetite of investors, they choose one of

these investment types. Then, both groups of investors conduct their own risk analysis. Thus, even if the information sensitivity of AAA and non-AAA tranches differs clearly, both types of investors can be considered as informed investors, only focusing on different investment types. This argument is also consistent with our *smart investors hypothesis*.

3.2 Do investors consider asymmetric information in pricing securitizations?

3.2.1 Full sample results

As postulated before, we expect that the credit spread for tranches without (qualified) retention is significantly higher than for tranches where the originator chooses equity retention. However, on the basis of a t-test the expectation seems not to hold. Using the equity retention as our base category, we find that the credit spread does not differ significantly if there is no retention. On the contrary, the vertical slice retention indeed leads to a higher credit spread, which is generally in line with the expectation. Though, these first results could be endogenous. For our further analysis, we build on the models and results of section 3.1. Therefore, we use the following specification:

$$\text{spread}_{it} = \alpha + \beta' \cdot \text{retention}_i + \gamma' \cdot \text{credit factors}_i + \delta' \cdot \text{credit rating}_i + \chi' \cdot \text{controls}_i + \lambda_i + \varepsilon_{it}, \quad (3)$$

where equity retention is the base category. However, without (see model (3.A)) as well as with inclusion (see models (3.B)-(3.D)) of credit related factors and additional variables, there is no relevant difference between any of the considered types of retention (see Table 7) implying the results not to be in line with the theoretical arguments. Consequently, on the basis of the full sample it could be concluded that investors do not consider asymmetric information at all in the pricing of securitizations. However, in the subsequent sections we analyze the effect of retention on the risk premium for information sensitive and information insensitive tranches separately.

[Table 7]

3.2.2 Results for investors of information sensitive tranches

Consistent to section 3.1, we consider only non-AAA tranches from ABS and MBS securitizations for our analyses of information sensitive tranches. Moreover, we use the same model specification as in section 3.2.1, where we described the full sample analysis:

$$\text{spread}_{it} = \alpha + \beta' \cdot \text{retention}_i + \gamma' \cdot \text{credit factors}_i + \delta' \cdot \text{credit rating}_i + \chi' \cdot \text{controls}_i + \lambda_t + \varepsilon_{it}. \quad (4)$$

As presented in Table 8, the results for the non-AAA tranches are substantially different from the full sample results. Considering credit factors and other important control variables, we find that retention has indeed a material impact on the risk premium required by investors. If there is no qualified retention, the credit spread is significantly higher compared to the base category (retention of the equity tranche). Similarly, vertical slice retention leads to significant higher credit spreads than equity retention. Both effects have a magnitude of more than 100bp and are thus of high economic relevance. These results are completely in line with theoretical arguments. The value of information sensitive tranches is very sensitive to the quality of the underlying assets. If screening and monitoring incentives of originators are low, which is the case if they do not retain a part of the deal or if they choose vertical slice instead of equity retention, investors anticipate these diverging interests. As a consequence, they only invest if they are compensated for it with an additional risk premium. Thus, the costs of asymmetric information have to be borne by originators and not by investors. These results strongly support our *smart investors hypothesis*.

[Table 8]

3.2.3 Results for investors of information insensitive tranches

Our analysis of information insensitive tranches is based on AAA tranches from ABS and MBS securitizations. Since all tranches have the same rating, the credit rating cannot be used as explanatory variable of credit spreads. Thus, we use the following specification for our regressions:

$$\text{spread}_{it} = \alpha + \beta' \cdot \text{retention}_i + \gamma' \cdot \text{credit factors}_i + \chi' \cdot \text{controls}_{it} + \varepsilon_{it} \quad (5)$$

In models (5.A) and (5.B) of Table 9, we present the results for the pooled sample of ABS and MBS securitizations. As expected, the impact of asymmetric information on credit spreads is much lower due to the information insensitive nature of these tranches. Interestingly, in contrast to the results for information sensitive tranches, vertical slice retention leads to a significantly lower credit spread than our base category, the equity retention. This is economically plausible. Even if most of the literature predicts that equity retention leads to the highest reduction of asymmetric information, this is not necessarily true from the perspective of investors of tranches which are very senior in the payment order due to the waterfall structure of securitizations. In a normal state of nature, the probability of default of AAA tranches is very unlikely. The risk of these tranches is mainly systematic so that a default of these tranches most probably occurs in economic downturns (Coval et al., 2009b).³ However, in economic downturn scenarios, an equity tranche is very likely to default completely. Thus, incentives of originators are very low when the impact of monitoring is most relevant from the perspective of AAA tranches. On the contrary, if originators choose vertical slice retention, they still have incentives to monitor the underlying loans. It should be noted that this does not mean that the *total* costs of asymmetric information can be minimized by retaining the vertical slice, but that vertical slice retention is favored by investors of very information insensitive tranches. A finding, which seems not to be economically plausible, is that investors seem to prefer if there

³ Due to this finding, Coval et al. (2009b) call these securities “economic catastrophe bonds”.

is no retention at all compared to equity retention. In order to explore this issue, we additionally present the models (5.C)–(5.F), where we split the AAA data into ABS and RMBS securitizations to check if this effect is endogenous. The reason for using only RMBS and not all MBS is that almost 98% of the MBS belong to this asset class. Thus, the drawback that the results could be biased is higher than the benefit of having a larger sample.

[Table 9]

We notice that some types of retention are only relevant for ABS whereas others are only relevant for RMBS. Furthermore, for RMBS there is only one asset class, which is the reason that no asset class fixed effects are considered. Moreover, we find that while asset class fixed effects are very important for ABS securitizations, the country of collateral seems to be irrelevant, leading to a reduction of the adjusted R^2 . Against this background, we present the results without country of collateral fixed effects. On the basis of these models (5.C)–(5.F), we find that the results concerning the category “no classified retention” are ambiguous. The coefficients are still negative which is not consistent with theoretical arguments. However, the magnitude is very small and the coefficients are not significant, meaning that investors do not require a substantially different risk premium whether originators keep the equity tranche or not. Recalling the high likelihood that the equity tranche completely defaults in states of nature which are mostly relevant for the value of AAA tranches, this finding can generally be justified. However, the results concerning the vertical slice are clearer. We can thus confirm that, for AAA investors, vertical slice retention leads to a lower required risk premium than equity retention, which again is in line with our *smart investors hypothesis*.

4 Conclusion

In this paper, we analyze whether investors have learned from the subprime mortgage crisis and improved their shortcomings. First, we study whether investors consider asymmetric information in pricing securitizations. Second, we examine the degree of their reliance on credit ratings. Our results strongly support our *smart investors hypothesis* regarding both of these aspects, showing that investors have indeed learned from their mistakes.

Consistent to theoretical arguments, we find that investors of non-AAA tranches require a high risk premium if the originator retains no material share of securitizations. Moreover, the credit spread of these tranches is significantly higher if the originator chooses vertical slice retention instead of equity retention, which brings about higher screening incentives. Furthermore, even investors of very information insensitive AAA tranches consider asymmetric information to some extent. These investors require slightly lower credit spreads if the originator retains a vertical slice instead of the equity tranche, which is very likely to completely default in scenarios most relevant for AAA tranches.

Furthermore, we find that the relevance of credit ratings on credit spreads has significantly decreased in comparison to the pre-crisis period. The importance of other credit factors, however, has increased. Moreover, our results suggest that ratings are mainly considered by investors to differentiate between information sensitive and insensitive tranches. Then, investors perform their own risk analyses for the relevant type of investment, which depends on their risk appetite. Thus, for both information sensitive and insensitive tranches, investors acquire additional information, suggesting that even for AAA tranches we mainly have informed investors.

Even if our results strongly support that we have smart investors operating on the market of securitizations, this does not prevent from future crises. Even though it seems that relevant shortcomings that contributed to the subprime mortgage crisis have largely been resolved, it is very important to analyze the causes of the crisis further. Only on this basis, a deeper under-

standing of the inherent relationships becomes possible, which enables investors to incorporate these issues.

Our results have important implications, first, for originators and, second, for the regulation of securitizations. First, originators should be aware that investors require a material risk premium if the degree of asymmetric information is high. Thus, in their own interest they should structure the deals in a way to assure high screening incentives. Second, regulatory rules should consider that investors may have already learned their lesson. Thus, the rules should not focus too much on prevention from identical (known) problems. In this regard our results suggest that rules regarding the disclosure of information, e.g. about the type and magnitude of retention, could reduce the costs of asymmetric information and thus be most beneficial.

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Table 1

Summary statistics: Composition of the data set

The sample comprises 584 European floating rate tranches issued in 2010 and 2011. Panel A and B describe the distribution of tranches across years and ratings. Panel C and D report summary statistics of asset classes and country of collateral.

	Obs.	Percentage
<i>Panel A: Year</i>		
2010	240	41.10
2011	344	58.90
<i>Panel B: Credit rating</i>		
AAA	428	73.12
AA	38	6.51
A	61	10.27
BBB	41	6.85
BB	7	1.20
B	8	1.37
CCC	4	0.68
<i>Panel C: Asset class</i>		
ABS	147	25.04
Auto ABS	79	13.53
Consumer ABS	27	4.62
Credit Cards	24	3.60
Lease ABS	11	1.88
Sonstige ABS	6	1.03
MBS	440	75.34
CMBS	8	1.37
Mix MBS	2	0.34
RMBS	430	73.63
<i>Panel D: Country of collateral</i>		
Belgium	10	1.74
France	17	2.96
Germany	56	9.76
Ireland	3	0.52
Italy	45	7.84
Mixed	3	0.52
Netherlands	176	30.66
Norway	3	0.52
Portugal	9	1.57
Spain	55	9.58
Sweden	10	1.74
United Kingdom	190	32.58

Table 2

Summary statistics: Credit factors

This table reports summary statistics of 584 floating rate tranches from 237 ABS and MBS deals issued in 2010 and 2011. The table shows descriptive statistics of credit spreads (dependent variable) and credit factors (independent variables). Subordination level is the percentage of total liabilities that is subordinate to the tranche. The volume corresponds to the nominal value of each tranche. WAL is the exposure weighted maturity of the loans. The credit spreads, subordination level, volume, and WAL are reported on tranche level, the number of tranches is reported on deal level.

	Obs.	Mean	Std. Dev.	Min.	q25	q50	q75	Max.
Credit spread (bp)	584	146.553	107.8121	5	90	130	165	950
Subordination level	584	0.1574	0.1248	0	0.0641	0.1515	0.2023	0.89
Volume (€ millions)	584	831.709	2180.367	1.5	147	409.5	893	47000
Weighted Average Life [WAL] (years)	519	4.66	3.98	0.74	2.15	3.96	5	30
Number of tranches	237	3.53	2.66	1	2	3	5	19

Table 3

Summary statistics: Distribution of retention types

This table describes the usage of different types of retention. The category “no qualified retention” refers to observations where retention is less than 5% or retention is not reported in the investment prospectus.

	2010	2011	Total
No qualified retention	148	20	168
Retention: vertical slice	0	22	22
Retention: seller’s share	60	62	122
Retention: random selection	0	13	13
Retention: equity	32	227	259

Table 4**Impact of credit factors on credit spreads**

The table reports OLS regression estimates of the influence of credit factors on credit spreads (in bp). We use three model specifications. Model 1 includes credit factors and quarter fixed effects. In model 2, fixed effects for the country of collateral are included. Model 3 additionally contains asset class fixed effects. t-statistics shown in parentheses are robust to heteroskedasticity. The symbols *, **, *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

	Full sample		
	(1.A)	(1.B)	(1.C)
Subordination level	-122.118*** (-3.328)	-126.520** (-3.556)	-146.016*** (-3.946)
Ln(volume)	-36.273*** (-10.916)	-33.703*** (-10.928)	-33.152*** (-10.753)
No. tranches	5.223*** (3.570)	2.784* (1.922)	2.308 (1.585)
WAL	1.572 (1.328)	2.122* (1.652)	2.040 (1.566)
MBS	6.573 (0.625)	-4.041 (-0.345)	
Constant	821.297*** (12.508)	856.640*** (12.484)	839.993*** (12.367)
Quarter FE	Yes	Yes	Yes
Country of collateral FE	No	Yes	Yes
Asset class FE	No	No	Yes
Observations	516	503	486
Adjusted R^2	0.341	0.440	0.450

Table 5**Impact of credit factors on credit spreads for information sensitive and information insensitive tranches**

The table reports OLS regression estimates of the influence of credit factors on credit spreads (in bp) for two sub-samples. The results on the left-hand side present results for 143 tranches with rating AA and lower, results on the right-hand side present results for 373 AAA tranches. t-statistics shown in parentheses are robust to heteroskedasticity. The symbols *, **, *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

	Non-AAA			AAA only		
	(1.D)	(1.E)	(1.F)	(1.G)	(1.H)	(1.I)
Subordination level	-383.711** (-2.358)	-522.903*** (-3.075)	-482.631*** (-2.686)	17.037 (0.650)	32.135 (1.309)	1.336 (0.066)
Ln(volume)	-50.360*** (-4.700)	-30.746*** (-2.973)	-25.437** (-2.168)	-6.337** (-2.228)	-1.959 (-0.673)	-2.730 (-0.959)
No. tranches	17.928*** (4.829)	15.436*** (3.519)	17.264*** (3.728)	2.022** (2.208)	0.703 (0.877)	0.000 (0.001)
WAL	-0.858 (-0.404)	-4.064 (-1.372)	-5.956* (-1.887)	1.220 (1.638)	2.337*** (3.361)	2.420*** (3.485)
MBS	-28.431 (-1.112)	-36.804 (-1.147)		3.309 (0.429)	6.079 (0.649)	
Constant	1083.778*** (6.013)	691.577*** (3.833)	572.944*** (2.838)	210.470*** (3.618)	127.299* (1.949)	157.514** (2.457)
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Country of collateral FE	No	Yes	Yes	No	Yes	Yes
Asset class FE	No	No	Yes	No	No	Yes
Observations	143	136	127	373	358	352
Adjusted R^2	0.345	0.481	0.497	0.055	0.214	0.336

Table 6

Impact of credit ratings on credit spreads

The table reports OLS regression estimates of the influence of credit ratings on credit spreads (in bp). We present four different models. In model 1 and 2, the impact of credit rating letters is analyzed using the full sample; the base category is AAA. In model 3 and 4, results are presented for non-AAA tranches; the base category is AA. For both samples, we perform regressions excluding credit factors (model 1 and 3) and including credit factors (model 2 and 4). t-statistics shown in parentheses are robust to heteroskedasticity. The symbols *, **, *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

	Full sample		Non-AAA	
	(2.A)	(2.B)	(2.C)	(2.D)
AA	87.003*** (6.154)	1.150 (0.063)		
A	74.999*** (4.724)	14.389 (0.766)	-13.143 (-0.580)	31.088 (1.433)
BBB	219.251*** (7.094)	136.931*** (4.250)	133.713*** (3.776)	114.959*** (3.522)
BB	195.529*** (3.915)	128.606*** (4.057)	106.083** (2.067)	141.513*** (4.330)
B	121.634 (1.197)	144.725 (1.221)	39.530 (0.380)	274.859** (2.029)
CCC	-22.122 (-1.210)	20.062 (0.618)	-112.604*** (-5.075)	194.970** (2.553)
Subordination level		-55.289* (-1.689)		-270.431 (-1.646)
Ln(volume)		-22.160*** (-5.282)		-21.986* (-1.978)
No. tranches		2.145* (1.663)		18.273*** (3.611)
WAL		0.814 (0.608)		-7.200* (-1.970)
Constant	113.041*** (12.445)	600.739*** (6.339)	232.535*** (8.594)	477.042** (2.493)
Quarter FE	Yes	Yes	Yes	Yes
Country of collateral FE	No	Yes	No	Yes
Asset class FE	No	Yes	No	Yes
Observations	584	486	157	127
Adjusted R^2	0.331	0.535	0.105	0.605

Table 7**Impact of asymmetric information on credit spreads**

The table reports results of OLS regressions relating the type of retention and credit spreads (in bp). The coefficients refer to the base category “equity retention”. In model 1, the only explanatory variables are the types of retention. Model 2–4 additionally include credit factors and credit rating letters. Further control variables are fixed effects for quarter, country of collateral, and asset class. The variables of model 2–4 correspond to those of Table 6. t-statistics shown in parentheses are robust to heteroskedasticity. The symbols *, **, *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

	(3.A)	(3.B)	(3.C)	(3.D)
No qualified retention	5.544 (0.524)	19.827 (1.561)	9.873 (0.800)	15.942 (1.282)
Retention: vertical slice	50.466** (2.129)	16.092 (0.698)	16.532 (0.782)	-2.760 (-0.122)
Retention: seller’s share	-31.432*** (-2.682)	3.897 (0.518)	-18.051* (-1.785)	-2.238 (-0.222)
Retention: random selection	-24.554 (-0.809)	-14.063 (-0.847)	6.099 (0.308)	11.685 (0.602)
Constant	150.170*** (22.645)	589.032*** (7.597)	573.895*** (6.216)	591.757*** (6.319)
Credit factors	No	Yes	Yes	Yes
Credit ratings	No	Yes	Yes	Yes
Quarter FE	No	Yes	Yes	Yes
Country of collateral FE	No	No	Yes	Yes
Asset class FE	No	No	No	Yes
Observations	584	516	503	486
Adjusted R^2	0.020	0.437	0.536	0.533

Table 8

Impact of asymmetric information on credit spreads for information sensitive tranches

The table reports results of OLS regressions relating the type of retention and credit spreads (in bp) for the sample of non-AAA tranches; the base category is “equity retention”. t-statistics shown in parentheses are robust to heteroskedasticity. The symbols *, **, *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

	(4.A)	(4.B)	(4.C)	(4.D)
No qualified retention	31.445 (1.192)	122.998*** (3.168)	101.865*** (2.759)	102.150** (2.555)
Retention: vertical slice	123.279** (2.204)	153.213*** (4.471)	151.385*** (3.683)	135.771** (2.134)
Retention: seller’s share	-188.664*** (-4.167)	-127.129*** (-3.377)	-143.694** (-2.291)	-132.530* (-1.906)
Retention: random selection	-65.471 (-1.027)	-58.815 (-1.447)	-10.832 (-0.289)	-13.112 (-0.350)
Constant	232.971*** (13.003)	795.687*** (4.707)	626.782*** (2.679)	616.230** (2.548)
Credit factors	No	Yes	Yes	Yes
Credit ratings	No	Yes	Yes	Yes
Quarter FE	No	Yes	Yes	Yes
Country of collateral FE	No	No	Yes	Yes
Asset class FE	No	No	No	Yes
Observations	157	143	141	136
Adjusted R^2	0.142	0.574	0.645	0.624

Table 9

Impact of asymmetric information on credit spreads for information insensitive tranches

The table reports results of OLS regressions relating the type of retention and credit spreads (in bp) for the sample of AAA tranches; the base category is “equity retention”. On the left side, results are shown for all AAA tranches, consisting of ABS and MBS. In the middle and on the right side, results are presented separately for RMBS tranches and ABS tranches, respectively. t-statistics shown in parentheses are robust to heteroskedasticity. The symbols *, **, *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

	ABS & MBS		RMBS		ABS	
	(5.A)	(5.B)	(5.C)	(5.D)	(5.E)	(5.F)
No qualified retention	-16.951* (-1.934)	-17.178** (-2.243)	-8.476 (-0.876)	-10.164 (-1.172)	-8.158 (-0.592)	-4.173 (-0.297)
Retention: vertical slice	-34.505** (-2.021)	-29.587** (-2.165)	-38.168** (-2.391)	-28.013** (-2.031)		
Retention: seller’s share	14.302** (2.523)	5.410 (0.770)	31.828*** (5.519)	5.956 (0.821)	-43.650*** (-3.328)	-40.010*** (-3.134)
Retention: random selection	-17.459 (-1.018)	-14.633 (-0.692)			3.093 (0.175)	8.069 (0.460)
Constant	188.032*** (3.262)	141.402** (2.183)	106.656 (1.620)	26.025 (0.368)	381.985*** (3.024)	438.309*** (3.720)
Credit factors	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Country of collateral FE	No	Yes	No	Yes	No	No
Asset class FE	No	Yes	No	No	No	Yes
Observations	373	350	279	272	84	81
Adjusted R ²	0.100	0.394	0.193	0.419	0.277	0.389