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Multi-tranche Securitisation Structures: More Than Just a Zero-Sum Game?

Abstract

This paper contributes to the literature by incorporating the factors that explain multi-tranche structuring and the yield offered by securitisation bonds into a comprehensive model. Results indicate that the degree of complexity of multi-tranche securitisation structures is related to market completeness and shortening of information asymmetry. We also find that the complexity of multi-tranche structure enables the yield offered by triple-A bonds to be reduced but not the average yield, with tranching being a zero-sum game. This research uses a database comprising all the MBS and ABS issues (1993-2011) in Spain, one of the world's main securitisation markets. Analysing this long period has enabled us, for the first time, to contrast the disruptive effect of the Great Financial Crisis on the relationships analysed in the securitisation market.

JEL Classification: G12; G21; G24.

Keywords: Securitisation; Primary yield; Tranche; Asymmetric information.

1. Introduction

Prior to 2007, the year in which the subprime crisis erupted, there was a dramatic increase in asset securitisation on international markets over a twenty-year period in terms of both volume and methods, making this a very powerful and dynamic source of financial innovation. Spain was no stranger to this phenomenon, and despite being a late starter it underwent a considerable rise in securitisation and became the leading market in continental Europe and the third biggest in the world[1]. This securitisation effectively helped to meet the high demand for financing in Spain during the period covered by this research (1993-2011).

The significance of securitisation bond issues can be explained not just by the volume associated with them but also by their quality. Thus, the vast majority of the securitisation bonds issued (i.e. of their overall volume) obtained the maximum rating (triple-A), not just in the pre-crisis period but also after the crisis had broken out (over 90% of the securitisation bonds issued in Spain obtained the maximum possible rating). At global level, in the years prior to the crisis securitisation issues accounted for more than two thirds of all triple-A issues (BCBS 2011).

Multi-tranche securitisation structures offer the possibility of generating fixed-yield securities with the highest rating[2] and, consequently, with a very low risk premium, is one of the factors that explain the intensive securitisation by issuers (Almazan et al. 2015; Farruggio and Uhde 2015; Benendo and Bruno 2012; Agostino and Mazzuca 2011; Cardone-Riportella et al. 2010).

The fact that the same pool of assets can serve as collateral for more than one series of bonds, with a preset order of precedence and therefore with different risk profiles, means that the needs of investors with very different profiles can be met. In regard to the trade-off between yield and security, securitisation bond issues have enabled the needs of both investors seeking riskless (triple-A) bonds and those of more speculative investors seeking higher yields to be addressed[3]. The contribution of securitisation to financial market completeness has resulted in increased overall demand for these bonds, which in turn has reduced the average yield offered. Moreover, the internal structuring of securitisation issues may have helped mitigate the problems arising from information asymmetries between investors and issuers of financial bonds.

At this point it must be clarified that multiple tranching is not free of charge: it leads to increased design, structuring, rating, placement and monitoring costs for the resulting tranches on primary markets (Schaber 2008; Schwarcz 1994), and the potential degree of liquidity of issues on secondary markets becomes more limited as the number of tranches increases and, therefore, the volume of each one decreases (Firla-Cuchra and Jenkinson 2005).

The effects and motivtions linked to multi-tranche structuring have been studied frequently from a theoretical viewpoint, but very few studies have linked this issue with the yield offered by securitisation bonds. Firla-Cuchra (2005) and Franke and Weber (2009) pioneered the empirical testing of the influence of multi-tranche structures on the risk premium required by securitisation bonds. Any way, these studies focus on securitisation tranches considered separately. We believe that this line needs to be take further, and that it is relevant and appropriate to analyse securitisation issues as a whole so as to examine the average yield offered by securitisation bonds for each fund in its entirety. In short, this means comparing whether tranching improves the conditions for the placement of all tranches or only senior tranches, in which case it comprises a zero-sum game.

Additionally, this paper contributes to the literature by incorporating the multi-tranche structure and securitisation bond yield variables into a single comprehensive model, using multivariate regressions integrated in a structured equations model.

Given these gaps in the scientific literature, we believe that there is good reason to analyse the factors underlying the generation of differentiated tranches in securitisation issues and the impact of such multi-tranche structures on investors' perceived risk as measured by the primary yield offered by securitisation bonds.

To that end this research is focusing on a market of major global significance (Spain), taking into consideration the total population of securitisation issues (100% coverage rate), over a very long period (1993-2011). Precisely, studying this long period has enabled us, for the first time, to examine the disruptive effect of the Great Financial Crisis (GFC) on the relationships analysed in the securitisation market.

The paper is structured as follows. Section Two reviews the main papers that have analysed the primary yield of securitisation bonds, with particular emphasis on the influence of the internal structure of these bond issues. Section Three sets out the approach used in our research hypotheses and Section Four specifies the models and shows the results obtained. Finally, we present the main conclusions.

2. Multi-tranche yield and structure design determinants: literature review

There have been few studies of the link between multi-tranche structuring and the yield offered by securitisation bonds, and their results have proved inconsistent. Firla-Cuchra (2005) introduced the empirical testing of the influence of multi-tranche structures on the risk premium required by securitisation bonds, focusing on securitisation tranches considered separately. Franke and Weber (2009) find a negative relationship between the number of tranches yield, linked to

European CDO (1997-2005). Schaber (2008) focuses on a very particular type of notes observed in securitisation transactions – combination notes (2002-2007) – and also finds a negative relationship between the number fo tranches and the yield on issues. By contrast, Vink y Thibeault (2008b) analyse non-USA ABS, MBS and CDO issues (1999-2005) and observe a positive relationship between the number of tranches and the yield of ABS issues. In any event, none of these studies incorporates GFC, even in the subsequent period.

Peña-Cerezo et al. (2014) do incorporate GFC into their study (1993-2011), but they analyse only Spanish MBS, the least complex (and most reliable) segment of the securitisation market, leaving out most of the population (ABS). For the period as a whole (they do not breakit down, so it is not possible to check for differences between the crisis and post-crisis periods) they find a significant negative relationship between the number of tranches and the yield of issues.

From a retrospective viewopint the state of the art seems to support a negative relationship between the number of tranches and the ield of issues, though not unanimously. In other words multi-tranche structuring seemsto favor the placement of securitisation issues on better terms. However it must be asked whether the heterogenety in the periods and issues studied, in the approaches used and in the types of yield analysed prevents sufficiently clear conclusions from being drawn as to the effectiveness of multi-tranche structuring in reducing the yield of issues.

Our intention here is precisely to focus on the analytical approach taken: to determinewhat is meant by the "effectiveness" of multi-tranche structuring and what different levels of effectiveness may emerge. As a result, we propose two levels of effectiveness of multi-tranche structuring.

"Weak effectiveness of multi-tranche structuring" emerges when tranching permits a trade-off between risk and yield fromthe more senior tranches to the riskier ones (equity), i.e. a mere internal transfer (or zero-sum game) between the different tranches into which an issue is divided.

“Strong effectiveness of multi-tranche structuring” emerges when tranching permits a net reduction in the weighted average yield of the whole set of tranches into which an issue isdivided, i.e. something more than a zero-sum game.

Thus, to assess the extent of the actual effectiveness of tranching we believe that its effect on the yield demanded of securitisation bonds should be analysed. This leads us to the following two research hypotheses, which are associated with the effectiveness of multi-tranche structures in securitisation issues on their primary yield:

H1 (weak effectiveness of multi-tranche structuring): the number of tranches into which an issue is divided as a negative effect on the yield of the senior bonds in the issue.

H2 (strong effectiveness of multi-tranche structuring): the number of tranches into which an issue is divided has a negative influence on the average weighted yield of the issue as a whole.

However, as acknowledged in Franke and Weber (2009: 27), “the analysis of tranche risk premia and relative risk premia is complicated by the fact that various effects interfere (…) More research is needed to further disentangle this effects”. In this paper we opt precisely to incorporated these effects into an integrated model. We thus consider both the potential direct and indirect effects (via the number of tranches) of the size and quality of securitization issues on their yield. Thus, to complete the explanatory model, the rest of the main factors considered in studies that analyse the primary yield of securitisation bond issues are outlined below. Figure 1 shows the model that brings together the hypotheses put forward.

[Figure 1]

Issue size is used as a proxy for the degree of diversification, given that larger issues take place by grouping assets, either from prominent credit institutions (which are highly likely to hold assets with widely differing characteristics) or by grouping credits from a large number of organisations. Diversification reduces risk and, as a result, reduces demanded yield, so the hypothesis associated with the effectiveness of the size of the asset pool in increasing the diversification of risks (Schaber 2008; DeMarzo 2005; Firla-Cuchra 2005; Duffie and Garleanu 2001; DeMarzo and Duffie 1999; Childs et al. 1996) can be worded as follows:

H3 (diversification): the size of the asset pool has a negative influence on the yield required of securitisation bonds as a whole.

In regard to the link between issue size and liquidity, it must also be highlighted that the Spanish securitisation market has never been characterised by excessive liquidity in regard to junior tranches. Given that these tranches have tended to be held by the originators themselves, we believe that it is more realistic to circumscribe our analysis to the liquidity of senior tranches.

Thus, the expected negative relationship between issue size and the yield required of senior tranches may be considered to be caused by the lower liquidity premiums demanded for higher-volume issues (Schaber 2008; Firla-Cuchra y Jenkinson 2005; Schwarcz 1994). The relevant hypothesis is worded as follows:

H4 (liquidity premium): the size of an issue has a negative influence on the yield demanded for senior bonds.

One reason to use multi- tranching is that there are financial markets that do not offer a full range of bonds capable of meeting the needs of all issuers and investors (Franke and Weber 2009; Firla-Cuchra 2005). The generation of new bonds that can cover needs not met by existing bonds is thus beneficial and may be expected to help to adapt the performance of securitisation bonds to different investor profiles and thus complete the market (Iacobucci and Winter 2005; Gaur et al. 2004; Plantin 2004; Riddiough 1997; Boot and Thakor 1993). The ability of multi-tranche structures to complete the market and meet the needs of heterogeneous investors may explain the low yield demanded of securitisation bonds (Shleifer and Vishny 1997; Duffie and Rahi 1995).

In any event, the advantage obtained by adapting a larger number of series of securitisation bonds to a greater diversity of investors should offset any loss in liquidity caused by the issuing of lower volumes (DeMarzo 2005; Mitchell 2005; DeMarzo and Duffie 1999). Thus, issues with greater volumes should best offset this loss in liquidity, which means that there is more incentive to structure issues in larger numbers of series.

Schaber (2008) defends the hypothesis that a segmented market should give rise to more complex issues. Firla-Cuchra and Jenkinson (2005) use issue sizes as a proxy for the effects of market segmentation; they propose and confirm, as do Schaber (2008) and Franke and Weber (2009) subsequently, that there is a direct link between issue size and the number of tranches placed on primary markets.

Thus, the hypothesis related to market completeness and segmentation is phrased as follows:

H5 (Segmentation/market completeness): The size of issues has a positive influence on the number of tranches.

The reasons for setting up multi-tranche structures may also include the solving of problems arising from information asymmetry. Information asymmetries in securitisation markets are due to 2 main reasons: (i) the originator of the assets is better aware of their quality than potential investors are; and (ii) the grouping of high volumes of assets into a single portfolio may make it difficult to monitor and scrutinise their quality. In any event it must be pointed out that in securitisation issues recorded in Spain (CNMV) there is no need to distinguish between fully funded true sale transactions and partially funded synthetic transactions because the latter are not regulated: all issues are true sale issues.

Gorton and Pennacchi (1990) argue that the costs associated with information asymmetries can be mitigated by designing financial bonds that segregate the resulting cash flows according to underlying assets. This reduction in the risk associated with senior bonds at the cost of junior (or subordinate) bonds can be taken as helping to reduce the average differential required of securitisation issues as a whole. Boot and Thakor (1993) deduce that an increase in the number of tranches reduces the variance in prices per tranche, and that higher levels of asset portfolio structuring are associated with more information-sensitive assets, in line with Riddiough (1997). Empirically, Firla-Cuchra and Jenkinson (2005) reach a similar conclusion: the degree of information asymmetry has significant impact on the number of tranches and on their type.

Moral hazard problems also arise from the logical lack of confidence felt by investors in regard to the possibility that originators may have incentives to transfer lower quality assets to securitisation funds and hold on to the safest ones on their own balance sheets (Plantin, 2004). Moreover, the consequences of laxity in the supervision of the regulator (or its outright absence) for the assets transferred become more serious the more uncertain the cash flows derived from those assets are. This in turn is negatively linked to the quality of the credits in question[4].

The lower the quality of the pool of assets transferred is (measured according to the ratings awarded by Credit Rating Agencies[5], controlled by type of collateral, size[6], guarantee cover, maturity, etc.), the higher the potential costs associated with moral hazard possibly incurred by the originator may logically be expected to be, in the sense of the possibility of ex-post actions being taken that are contrary to the interests of bondholders (changes in behaviour, lack of due diligence, etc.).

In short, as a yardstick for moral hazard it can be considered that the lower the overall quality of the pool of assets is, the more tranches the issue will be divided into, so as to reward senior bond-holders for taking part in issues backed by lower quality assets. And negative relationship can therefore be expected between the quality of the pool of assets transferred and the number of tranches per issue (Franke and Weber 2009; Schaber 2008; Firla-Cuchra and Jenkinson 2005; Riddiough 1997; Boot and Thakor 1993; Gorton and Pennacchi 1990). At the same time, the issuers who manage the safest asset portfolios have less incentive to incur the higher costs entailed by generating many series of bonds. The hypothesis associated with the generation of tranches with a view to reducing moral hazard problems can therefore be worded as follows:

H6 (moral hazard): the quality of an issue has a negative effect on the number of tranches.

Apart from the factors already considered, we also need to factor in a number of variables traditionally linked to determining the yield of securitisation bonds that act as control variables in the explanatory model proposed. Such variables include the rating awarded (especially when issues are highly complex), the underlying asset portfolio, the number of agencies that award ratings for each issue, the credit enhancement associated with the provision of public sector guarantees, the maturity period of bonds, the market interest rate and time dummies to measure the level of sophistication of markets and investors and the effect of the crisis (Peña-Cerezo et al. 2013; Vink and Fabozzi 2009; Vink and Thibeault 2008a, 2008b; Firla-Cuchra and Jenkinson 2005; Firla-Cuchra 2005; Beccacece and Tasca 2002).

3. Empirical methodology

3.1. Data and sources

The population studied in this section extends to all the mortgage-backed securitisation (MBS) and asset-backed securitisation (ABS) funds set up in Spain in regard to assets transferred by credit institutions as from the introduction of securitisation in 1993 up to December 2011. The analysis does not extend to FTA-CM[7], securitisation funds that offer some tranches of bonds whose yield is constant or unknown *a priori*[8], and those structured around a single bond tranche[9]. In all 503 securitisation funds met all the requirements for this period, with a total of 1959 series or tranches of bonds issued. The total volumen of the bonds issued by these 503 funds was 535672 millions of euros.

The main source of information used in this study can be found in the prospectuses submitted by securitisation fund managers (referred to here by their Spanish acronym SGFT) for verification and registration by the Spanish Securities and Exchange Commission (CNMV) in regard to each securitisation fund set up in Spain between 1993 and 2011. Most of these prospectuses were obtained from the website of the AIAF (Spain's official market for fixed income securities: www.aiaf.es), where most of these securitisation bond issues in Spain were placed, and from the website of the CNMV (www.cnmv.es). When searching both these sites proved unsuccessful, we opted for requesting the prospectuses on the relevant issues directly from the originators (credit institutions) or the SGFT responsible for the funds.

3.2. Definition of variables

After this explanation of the relationships included in our analysis, it is now time to specify what variables we use and how they were calculated.

The primary yield offered by the securitisation bonds considered here is represented by two variables:

a) The weighted average yield premium on all the tranches for each issue [*YieldAVE*]. The weighted average margin for each fund is calculated in a way similar to that used in previous studies (Firla-Cuchra and Jenkinson 2005; Firla-Cuchra 2005, Beccacece and Tasca 2002), i.e. by multiplying the differential or margin (in base points, referring to the EURIBOR-3M interest rate) of each tranche (including equity tranche) by the weight accounted for by that tranche in the total issue.

b) The weighted average yield premium on those securitisation bond tranches which obtain the maximum credit rating (AAA) [*YieldAAA*]. This variable is calculated in much the same way as the previous one, but taking into account only those tranches which have the maximum rating (equity tranche is never considered). There are two reasons for considering the primary yield of senior tranches *senior* (*YieldAAA*) separately from that of issues as a whole (*YieldAVE*): the first is that it is mainly the top-rated securitisation bonds that are placed on the market (or at least it was so prior to the GFC). This means that the primary yield of those bonds is particularly powerful in terms of information, since it must meet the requirements of investors. The second is that we believe that the proportion of the total issues produced accounted for by senior bond issues (around 90%) is so great that they merit separate analysis[10].

The specific variable used to measure the internal structure of the fund is the following:

c) Number of tranches into which the issue is divided [*Ntranches*]. The natural logarithm of the number of tranches or classes into which the issue is divided (market classes) is taken, regardless of whether or not they have different credit ratings.

The specific variables considered as regards the credit quality of securitisation funds are the following:

d) Weighted average rating [*WAR*]. A single numerical rating per issue is allocated, measured as the weighted average rating calculated on the basis of the credit rating awarded to each tranche of securitisation bonds generated and the relative weight of that tranche in the total bond issue, including equity tranche. For this porpuse, we transform qualitative measures of risk into quantitative measures of risk (a common practice: Bodenstedt et al. 2013; Jorion et al. 2005). The numerical scale used for each rating goes from 1 (D, Bankrupt) to 22 (AAA/Aaa).

e) Subordination or "attachment point of the AAA-tranche" *[Subordination]*. This indicates the relative weights of the subordínate tranches with respect to the total. The term "subordinate tranche" describes those tranches made up of securitisation bonds that meet the following requirements: (i) they form part of multi-tranche issues; (ii) they have been assigned a lower rating than senior securitisation bonds; and (iii) they are subordínate to senior bonds.

f) Number of rating agencies [*Nrating*]. This is measured as the number of official rating agencies called in simultaneously to assess the credit quality of the various securitisation bond tranches.

g) Percentage of the issue guaranteed [*Guarantee*]. This is calculated as the percentage of the total volume of the fund accounted for by the tranches which is guaranteed by a public institution.

h) Type of collateral. Funds are identified according to the type of collateral that they use. In Spain the securitisation issues are quite internally homogeneous; thus if an issue is collateralised by (i.e.) PML loans then all loans are of that type. In order from lowest to highest risk, the main types of collateral are PML, ("prime mortgage loans", i.e. loans with a loan-to-value below 80%, supported only by first mortgages), MTC ("mortgage transfer certificates", i.e. a mix of prime, prime A and subprime mortgage loans –this is the least homogeneous category), SME ("small and medium enterprise loans"), EL ("enterprise loans") and P&C ("personal and consumer loans"). The last category, which is excluded from the model to avoid perfect collinearity of the other type-of-collateral dummies, is "Other loans" (Nuclear Moratorium, Electricity Deficit, Wind Power Infrastructure Loans, Government Loans, etc.). This is a small, heterogeneous group of ABS collaterals often guaranteed by the government, with the lowest risk premium. These dummies can be related to the purpose of securitisation (Casu et al. 2011), and can consequently be used as controls linked to the risk and the asymmetric information inherent in the issue.

The specific variables considered in regard to the financial characteristics of securitisation funds/bonds are the following:

i) Maturity of securitisation bonds *[Maturity]*, calculated as the maximum lifetime of the issue, i.e. the residual lifetime (in years) of the longest loan (collateral) transferred to the fund.

j) Size of issue *[Size]*. This is calculated via the natural logarithm of the total volume, or nominal value, (in millions of euros) of each issue.

The specific variables for the originators are as follows:

k) Type of originator. Four dummies are set up so as to incorporate the type of originator. Credit institutions in Spain may belong to one of the following groups (control variables used): commercial banks *[CB]*, savings banks *[SB]*, credit cooperatives *[CC]* and financial credit establishments *[FCE]*. The latter have been involved in securitisation issues more heavily backed by consumer credit and subprime mortgages. The issue is labeled with one of these dummies if all the originators participating in it belong to a single category. The last category, excluded from the model to avoid perfect collinearity of the other type-of-originator dummies, is *[Mix]*, related to issues in which there is more than one type of originator.

The specific variables for financial markets are the following:

l) Government bond yields [*B10*]. Since securitisation bonds are long-term financial assets the yield of the 10 year Spanish bond is incorporated as a control variable, in line with other related studies (Gorton and Metrick 2012; Schaber 2008; Firla-Cuchra and Jenkinson 2005; Firla-Cuchra 2005).

The time-specific variables (dummies) are the following:

m) The "innovation" effect *[Innovation]*. This dummy variable takes a value of 1 if the fund was set up in 1993-1995 and 0 otherwise. This three-year period is considered as a period of introduction, learning and adaptation in regard to this type of financial asset on the Spanish market.

n) The "crisis" effect[11] *[Crisis]*. This takes a value of 1 if the fund was set up from August 2007 onwards and 0 otherwise.

3.3. Empirical model

To check the validity of the model and the hypotheses proposed, we apply a path analysis-type structural equation modelling (SEM), given that all the variables used are observable. All the analysis are conducted using the AMOS 20 statistics package.

Structural equation modelling is a natural extension of regression analysis. It enables us to estimate the effect of and the links between multiple variables and thus makes regression models more flexible. It was chosen here because it overcomes some of the limitations inherent in the multiple linear regression model method (the most widely used method in previous studies on this matter). More specifically: (i) it reduces drawbacks linked to collinearity between explanatory variables, because SEM enables correlations between explanatory variables to be calculated and integrated in the model itself; (ii) it enables more than one dependent variable to be integrated into a single model, at different levels[12], thus helping to provide a comprehensive, joint view of the variables analysed and avoiding the endogeneity problem that would potentially arise if multiple regression were used (Lleras, 2005); (iii) it provides sufficient flexibility for the same factor to be able to explain two variables jointly at the same time, with no need to force the model so that each factor can explain only one variable (Hair et al. 1999); and (iv) it provides a variety of goodness of fit indices, ideally including absolute and parsimonious fit indices (Hancock and Mueller, 2003), thus complementing the R-square available when multiple regression is used and helping researchers to assess the quality of the fit. The biggest advantage obtained is that the type and direction of the links expected between the different variables contained in the model can be proposed. For this reason these models are also known as confirmatory models.

In short, the general regression models for explaining the yield on securitisation bonds used to check hypotheses H1 and H4 are formulated as follows:

$$YieldAAA_i = \alpha_o + \alpha_1 Ntranches_i + \alpha_2 Size_i + \alpha_3 WAR_i + \alpha_4 Subordination_i + \alpha_5 Nrating_i + \alpha_6 Guarantee_i + \alpha_7 PML_i + \alpha_8 MTC_i + \alpha_9 EL_i + \alpha_{10} SME_i + \alpha_{11} P\&C_i + \alpha_{12} Maturity_i + \alpha_{13} CB_i + \alpha_{14} SB_i + \alpha_{15} CC_i + \alpha_{16} FCE_i + \alpha_{17} B10_i + \alpha_{18} Nissuers_i + \alpha_{19} Innovation_i + \varepsilon_i \quad (1)$$

Similarly, for YieldAve, the model that serves as the basis for checking hypotheses H2 and H3 is:

$$YieldAve_i = \beta_o + \beta_1 Ntranches_i + \beta_2 Size_i + \beta_3 WAR_i + \beta_4 Subordination_i + \beta_5 Nrating_i + \beta_6 Guarantee_i + \beta_7 PML_i + \beta_8 MTC_i + \beta_9 EL_i + \beta_{10} SME_i + \beta_{11} P\&C_i + \beta_{12} Maturity_i + \beta_{13} CB_i + \beta_{14} SB_i + \beta_{15} CC_i + \beta_{16} FCE_i + \beta_{17} B10_i + \beta_{18} Nissuers_i + \beta_{19} Innovation_i + \zeta_i \quad (2)$$

In turn, to discern the direct influence of the explanatory variables on yield from the indirect influence due to their effect on the generation of multiple tranches (hypotheses H5 and H6) the following explanatory model is generated for Ntranches:

$$\text{Ntranches}_i = \gamma_o + \gamma_1\text{Size}_i + \gamma_2\text{WAR}_i + \gamma_3\text{Subordination}_i + \gamma_4\text{Nrating}_i + \gamma_5\text{Guarantee}_i + \gamma_6\text{PML}_i + \gamma_7\text{MTC}_i + \gamma_8\text{EL}_i + \gamma_9\text{SME}_i + \gamma_{10}\text{P\&C}_i + \gamma_{11}\text{Maturity}_i + \gamma_{12}\text{CB}_i + \gamma_{13}\text{SB}_i + \gamma_{14}\text{CC}_i + \gamma_{15}\text{FCE}_i + \gamma_{16}\text{B}_{10i} + \gamma_{17}\text{Nissuers}_i + \gamma_{18}\text{Innovation}_i + \eta i \quad (3)$$

When the control variables are grouped the models look like this:

$$\text{YieldAAA}_i = \alpha o + \alpha_1\text{Ntranches}_i + \alpha_2\text{Size}_i + \sum_{j=3}^{17}\alpha_j \cdot \text{Control}_{ji} + \varepsilon i \quad (4)$$

$$\text{YieldAve}_i = \beta o + \beta_1\text{Ntranches}_i + \beta_2\text{Size}_i + \sum_{j=3}^{17}\beta_j \cdot \text{Control}_{ji} + \zeta i \quad (5)$$

Where:

$$\text{Ntranches}_i = \gamma o + \gamma_1\text{Size}_i + \gamma_2\text{WAR}_i + \gamma_3\text{Subordination}_i + \sum_{j=4}^{16}\gamma_j \cdot \text{Control}_{ji} + \eta i \quad (6)$$

4. Results

4.1. Univariate and bivariate analyses

The exposition of our results begins with an analysis of the variables that describe the yield of securitisation funds (*YieldAVE* and *YieldAAA*), taking the dichotomous variable *Crisis* as the classifying factor. Based on the results of the Kolmogorov-Smirnov test, the idea that *YieldAVE* (Z-value of the test statistic = 3.75, p-value < 0.01, Mean = 33.98, Standard Deviation = 24.75) and *YieldAAA* (Z-value of the test statistic = 5.34, p-value < 0.01, Mean = 26.76, Standard Deviation = 21.74) follow a normal distribution in the complete 1993-2011 period can be rejected. Moreover, Levene's test reveals that there is no homoscedasticity for *YieldAVE* (L-value of the test statistic = 80.14, p-value < 0.01) and *YieldAAA* (L-value of the test statistic = 41.17, p-value < 0.01). Using the corresponding means comparison test[13], these results support the aprioristic assumption that both average *YieldAVE* and average *YieldAAA* are lower in the pre-crisis period than during the crisis.

In short, it is empirically confirmed that the *Crisis* factor has a very powerful effect on the value of premiums. The fact that securitisation bonds issued in 2008-2011 were not placed on markets resulted in an illogical determination of coupons from the viewpoint of the reward required for risk[14]. In short, a weaker relationship (and one that is in any event insufficient from a market viewpoint) can be observed between the perceived risk entailed by bonds and the reward offered during the crisis period than during the pre-crisis period. This suggests that the multivariate analysis should be set up to incorporate the moderating effect of the crisis on the explanatory models.

Table 1 shows the number and volume of funds set up in each of the two periods within the population of securitisation funds analysed, classified according to types of collateral.

[Table 1]

In the analyses below the total population of securitisation funds is divided according to the period in which each fund was set up. This is done for two reasons: to check whether different yield patterns can be observed for the pre-crisis and crisis periods; and if so to draw up better fitting models to explain securitisation bond yields for each period.

To that end, before we introduce multivariate analysis a statistical summary of the measurement variables analysed is presented in Table 2, taking the *Crisis* variable as the classifying factor. It can be observed that the period in which the fund is set up strongly affects not only the two representative variables for yield, as shown above, but also some of the explanatory variables for yield. Thus, the weighted average rating (*WAR)* –above all its minimum value– is lower in 2008-2011, as a logical consequence of the drop in quality perceived in regard to this type of bond. Albeit to a lesser extent, an increase is also observed in the average values for *Guarantee* and *Maturity*, and a drop in the average for *Nrating*.

[Table 2]

4.2. Multivariate analysis

First of all, to obtain a comprehensive view of the set of relationships incorporated in the model (both those explicitly proposed in the hypotheses put forward and those linked to control variables), Table 3 shows the value of the coefficients and the measures of goodness of fit commonly used in multiple regression models with the SEM method, in which the main dependent variables are Yield AAA and Yield AVE, with the Ntranche moderating variable acting simultaneously as an explanatory variable (for Yield AAA and Yield AVE) and as a dependent variable.

[Table 3]

Given the significance of the impact of the GFC on securitisation, each model proposed is run for both the pre-crisis period (models 1-8) and the crisis period itself (models 9-16). For each model, three alternatives are also proposed to incorporate the risk factor for issues: (i) simultaneous use of WAR and Subordination (models 1, 5, 9 and 13); (ii) using only WAR (models 2, 6, 10 and 14); and (iii) using only Subordination (models 3, 7, 11 and 15). As shown in the results in Table 3, in most cases the simultaneous incorporation of the two variables does not improve the goodness of fit (either the difference in the coefficient of determination R^2 is scarcely appreciable or there is actually a decrease). In turn, WAR reaches higher significance levels than Subordination both in the explanatory models for YieldAAA and YieldAVE and in Ntranches. Therefore, taking into account the close correlation between WAR and Subordination (Pearson $\text{Correlation}_{\text{War-Subordination}} = -0.830^{***}$), to avoid problems of collinearity in our models and gain parsimony we opted for WAR as our only main variable[15] representing the risk level inherent in issues (models 3, 7, 11 and 15). Finally (models 4, 8, 12 and 16 in Table 3), we show the models in which only the control variables are included (these are the same ones for both periods, so *Innovation* is not included), which prove to be significant. The criterion chosen for the configuration of the four debugged regression models (4, 8, 12 and 16) is to incorporate in all models (so that they are homogeneous one with another) those control variables which prove to be significant on at least one occasion, with the aim of reducing collinearity between control variables.

To overcome the possible undesirable effects of the absence of multivariate normality of the models (Normalised Mardia Test > 1.96, p-value < 0.05), based on evidence in the literature on the convenience of using the bootstrapping approach to deal with non-normal data (Hayes, 2013, Sufahani and Ahmad, 2012) we use that approach to calculate confidence intervals for the estimated parameters in the four debugged models (4, 8, 12 and 16)[16].

In addition, a multi-sample path analysis is conducted to check the hypotheses put forward, with the population divided into the two aforesaid periods, the first running from 1993 to the outbreak of the sub-prime crisis (August 2007) and the second from September 2007 to December 2011. In the theoretical model posited (see Figure 1) it is established that the main independent variables (*Size* and *WAR*) and the control variables influence the dependent variables associated with tranche yield (*YieldAAA* and *YieldAVE*) both directly and indirectly via the *Ntranches* variable, which acts as the mediator variable in the model. Moreover, in this model the crisis acts as a moderating variable, and can affect the sign and magnitude of the effects of some variables on others. In this model, also to reduce collinearity problems and increse the parsimony of the model, we only include those control variables that have a significant influence on the dependent variables (Tables 4 and 5 and Figure 2).

We believe that the type of analysis used –multi-group SEM– is highly appropriate in this case, as it enables the moderating effects of the crisis on each of the relationships posited to be assessed directly, that is, it enables us to analyse whether the relationship between key variables changes before and after the GFC. In this sense, Ahn (2002) mantains that path analysis is not a substitute of regression analysis but rather a complement for it. We also believe that the use of multi-group analysis to test moderation is appropriate in this case. Some researchers have criticised this approach when the moderating variable is numerical (Hayes, 2005; Preacher et al., 2005; MacCallum et al., 2002), but this is not the case here, as the moderator (crisis) is not numerical.

The analysis conducted produces estimates for each of the two groups and goodness of fit indicators for both groups simultaneously. In turn, given the absence of multivariate normality in the data for both the pre-crisis period (Normalized Mardia Test (M) for $YieldAAA_{\text{Precrisis}} = 31.30$, $p < 0.01$; M for $YieldAve_{\text{Precrisis}} = 32.37$, $p < 0.01$) and the crisis period (M $YieldAAA_{\text{Crisis}} = 13.59$, p <

0.01; M for $YieldAve_{\text{Crisis}}$ = 8.00, $p < 0.01$), we opted to supplement the values of the estimators (calculated using the maximum likelihood method) with the confidence interval calculated via the bootstrap technique for each estimator (Malhotra et al. 2014). The results were observed to be similar.

The multi-sample goodness-of-fit indicators calculated via the AMOS 20 statistics package show highly suitable figures, as evidenced in Table 4, thus supporting the idea that the model posited fits the data highly satisfactorily, especially in the pre-crisis period.

The results obtained support most of the relationships posited. The obtaining of critical ratios for the difference in parameters between groups also confirms that some of the coefficients estimated are different in each group. This suggests that the GFC may have significant moderating effects (see Table 4 and Figure 2). As shown, significant differences can be seen between the pre-crisis and crisis periods for the estimations corresponding to some of the relationships studied.

First of all, in regard to the weak effectiveness hypothesis (H1) our findings show a significant negative coefficient for the relationship between *Ntranches* and *YieldAAA* in the pre-crisis period ($Ntranches\text{-}YieldAAA_{Precrisis}$ = –3.052) and a positive but non-significant coefficient during the crisis period ($Ntranches\text{-}YieldAAA_{Crisis}$ = 0.042). Although these coefficients are markedly different, the critical ratio obtained does not support the idea of a moderating effect of the crisis on the relationship posited (CR = 0.81, $p > 0.1$). H1 is therefore supported only partly, since the effect posited is observed only during the pre-crisis period.

Secondly, our findings do not support the strong efficiency hypothesis (H2), since the coefficients of the relationship between *Ntranches* and *YieldAVE* are both positive ($Ntranches\text{-}YieldAVE_{Precrisis}$ = 0.352; $Ntranches\text{-}YieldAVE_{Crisis}$ = 7.539), contrary to expectations. Pairwise parameter comparison results do not support the idea of a moderating effect of the crisis (CR = 1.55, $p > 0.1$).

In third place, the analysis conducted reveals that the relationship between *Size* and *YieldAVE* is negative and significant for the pre-crisis period ($Size\text{-}YieldAVE_{Precrisis} = -1.942$) and positive but non-significant ($Size\text{-}YieldAVE_{Crisis} = 1.779$) during the crisis. Moreover, a moderating effect of the crisis is observed (CR = 2.48, $p < 0.05$). These findings support the diversification hypothesis (H3) in the pre-crisis period and show the need to include the economic crisis as a moderating factor in the analysis conducted.

In fourth place, in regard to the liquidity hypothesis (H4) the analysis conducted reveals significant effects, but with different signs, for the relationship between *Size* and *YieldAAA* in the pre-crisis period ($Size\text{-}YieldAAA_{Precrisis} = -1.465$) and during the crisis ($Size\text{-}YieldAAA_{Crisis} = 3.775$). Once again, the moderation analyses conducted (CR = 4.23, $p < 0.05$) clearly support the idea that two periods must be differentiated in this analysis in order to obtain more precise estimates of the coefficients of the model.

In fifth place, in regard to the market completeness hypothesis our results indicate that the *Size* variable has a positive and significant influence on the *Ntranches* variable both in the pre-crisis period ($Size\text{-}Ntranches_{Precrisis} = 0.087$), and during the crisis itself ($Size\text{-}Ntranches_{Crisis} = 0.036$), but no significant differences are observed between the two periods (CR = –1.54, $p > 0.1$). These findings support H5.

Finally, our findings indicate that the *WAR* variable has a significant negative effect on *Ntranches* both in the pre-crisis period ($WAR\text{-}Ntranches_{Precrisis} = -0.368$) and during the crisis ($WAR\text{-}Ntranches_{Crisis} = -0.025$). Furthermore, the difference between the two coefficients is significant, with a significantly greater negative effect being observed in the pre-crisis period (CR = 6.55, $p < 0.01$) than subsequently. These findings support the hypothesis concerned with moral hazard (H6). They also support the idea that the crisis has a moderating effect on this relationship.

[Table 4]

[Figure 2]

4.3. Discussion of results

Considering first the question posed in the title of this article, that is, if securitisation would be more than a zero-sum game, in the sense of that the higher complexity of an issue (the higher number of tranches) is able to reduce the average riskiness and consequently the yield of the issue (strong effectiveness), the answer in this case, for the whole of issues analyzed and for the period under consideration, is clearly negative. It can be observed that, both in the pre-crisis period, as after the crisis, the greater complexity of emissions does not reduce their joint yield. Therefore, the hypothesis of the strong effectiveness of tranching is rejected.

This result, being contrary to those obtained by Franke & Weber (2009) for the European CDO market and those of Peña-Cerezo et al. (2014) for the Spanish MBS market, requires some additional considerations about the possible causes of such discrepancies.

Thus, in the case of Franke & Weber (2009), the study focuses on European CDO, a type of issues with underlying assets (loans and bonds) different to Spanish ABS and MBS considered in this article. In addition, the period covered in the study (1997-2005) does not include the consequences of the crisis. But what, in our opinion, can contribute mainly to explain the discrepancies in this case, is that the authors exclude from the analysis the equity tranche, or First Loss Position, so that the negative relationship found between the number of tranches and the average risk premium refers only to the rated tranches, not to the whole issue. It is very possible that if for this type of securitisation bonds has had included the equity tranche in the average risk premium, the results would not be so favourable to the hypothesis of strong effectiveness.

As for Peña-Cerezo et al. (2014), it covers the same period as our study but does not divide it into pre-crisis and crisissub-periods (and does not therefore isolate the effects of the crisis), and refers only to Spanish MBS issues. As a result, the strong effectiveness seems to occur in the Spanish case for MBS (and for the whole period), but not for the whole of MBS and ABS. In any case, are necessary additional studies that will contribute to more clearly elucidate the effect of factors such as the type of securitization issues, the territorial area covered, or the time interval considered, on the relationship between the complexity of an issue and reduction of the average risk premium.

Another important finding of this study is the influence of the crisis on many of the considered relations. Thus, considering first the effect of the number of tranches on the average risk premium, it can be seen that, while in the pre-crisis period the effect is not significant, in the crisis period the effect is positive and significant at 0.1 level, denoting that after the Great Financial Crisis the complexity of emissions is indicatively related to the perceived risk of issues. Based on two subsets the simple cross-validation analysis conducted shows that the stability of the model proposed is in any event low in the crisis period. We consider that these results are due to the peculiar characteristics of this period, in which the primary profitability of emissions did not reflect market conditions and the decisions of investors, because the originators chose to acquire the bonds themselves, as we will see later.

The effect of the crisis was also reflected in the relationship between the number of tranches and the yield of senior bonds. Thus, it can be observed that in the pre-crisis period the funds with more complex structures place their senior tranches at lower yield premiums. This confirms the effectiveness of multi-tranche structures in sheltering the most privileged tranches from the overall risk of the portfolios of assets transferred and in reallocate the risk amongst investors with different risk appetites, and also confirms for Spanish ABS and MBS the weak effectiveness of multi-tranche structuring, as found by Peña-Cerezo et al. (2014) for Spanish MBS and Franke & Weber (2009) for European CDO. By contrast, during the crisis period no such effectiveness is observed, because at that time the issues produced (including senior tranches) were not designed to be placed on markets, so the risk premiums offered (not those demanded) ceased to be linked to the number of tranches.

In fact, after the disruption in the market that formed with the outbreak of the sub-prime crisis, the coefficient of determination of the explanatory model for the yield of triple-A bonds decreased by half. We believe that this is because in the years of the crisis the primary yield offered by securitisation bonds ceased to reflect what investors were willing to demand in order to acquire such bonds. Evidence supporting this contention can be found in the prospectuses on issues themselves, which literally reveal the intentions of issuers that bonds should not be placed on markets but rather acquired or withheld by their originators. Considering that the market demanded too high a yield, originators opted to acquire these bonds themselves so as to use them as collateral for obtain short term funding from European Central Bank on advantageous terms.; and, where appropriate, to place them on secondary markets on less burdensome terms in the medium and long run if and when the markets returned to normal.

Turning to the relationship between *NTranches* and *YieldAVE*, as far as the coefficient of determination is concerned, it can be observed that the fit in the pre-crisis period is significantly worse than that obtained by the explanatory model for triple-A bond yields. We believe that this is because of the aforementioned widespread intention not to place mezzanine and equity tranches with investors on market terms (López-Penabad et al., 2015).

In short, a sudden fall in the informational power of the yield offered by securitisation bonds is observed when issues are not designed actually to be placed competitively with investors, either because certain tranches (mezzanine and equity) were designed originally to be held back by their originators or because the market is temporarily unable to absorb those issues (crisis period).

In any event, we consider that special emphasis must be placed on the power of multi-tranche securitisation structure designs to reduce the risk perceived by senior investors and thus the yield offered by most securitisation bonds, given that senior tranches account for around

90% of all securitisation issues (95% during the pre-crisis period) and are those which are mainly designed to be placed on markets.

The results for the explanatory power of the models associated with the number of tranches (*Ntranches*) are along the same lines. In the pre-crisis period a highly satisfactory coefficient of determination is observed (higher or much higher than that found in preceding studies) which is well in excess of 50%, but in the the crisis period falls to half that figure. It can thus be confirmed that the design of multi-tranche structures is better explained when attempts are made to place the different series of bonds on capital markets (as in the pre-crisis period). Logically, if the risk premium offered on bonds loses part of its informational value when they are not designed and issued to be placed with investors the same can be said of the internal structures of the relevant issues. Accordingly, after the crisis it can be seen that the tranching of securitisation operations ceases to have any substantial influence in determining the yield of senior tranches, by contrast with the situation observed in the preceding period.

The overall fit of the models is fairly good, especially in the pre-crisis period, and is better than that observed in previous studies (Schaber, 2008; Vink & Thibeault, 2008a & 2008b; Firla-Cuchra & Jenkinson, 2005; and Firla-Cuchra, 2005). In any event, the results of the simple cross validation conducted lead us to conclude that inthe crisis period there is less stability and reliability in the degree of fit of the models.

Taking into account the dissimilar results obtained in the pre-crisis and crisis periods we believe that we were right to divide the total population of securitisation funds into two periods for separate analysis (multi-group analysis). The disruptive influence of the sub-prime crisis is beyond doubt, as highlighted previously by Beccalli et al. (2015) and by Bonaccorsi di Patti and Sette (2016), as is its moderating effect (pre-crisis period *vs.* crisis period) on the determinants for the generation of multi-tranche structures and on bond yields.

As regards the main factors underlying the design of multi-tranche structures, it can be observed that the generation of multiple tranches is favoured by large issue volumes, thus in turn favouring the generation of a wide range of bonds suited to investors with different profiles and helping to set up more complete markets. Similar results can be observed in earlier studies covering the Spanish MBS market (Peña-Cerezo et al., 2014) and other European cases (Franke & Weber, 2009; Schaber, 2008; Firla-Cuchra, 2005; Firla-Cuchra & Jenkinson, 2005).

From the moral hazard standpoint, the expected inverse relationship can be observed between quality and the number of tranches, as found in previous papers (Franke & Weber, 2009; Schaber, 2008; Firla-Cuchra & Jenkinson, 2005; Firla-Cuchra, 2005). This validates the models put forward previously by Boot & Thakor (1993) and Riddiough (1997), confirming that the generation of additional tranches of bonds is a necessary cost that must be incurred to offset the risk received by investors, and is consistent with Martínez-Solano et al. (2009) who defend, after examine (by event study methodology) the reaction on the Spanish stock market to the announcement of 44 securitisation issues, that market discipline reduces moral hazard.

Finally, bond yields in the pre-crisis period are not only influenced by tranching: fund sizes also have a crucial influence – in the expected direction – in determining the differentials demanded. Both the yield from senior tranches and the overall yield from issues are inversely linked to fund size (*Size*), in line with the findings of Schaber (2008), Firla-Cuchra & Jenkinson (2005) and Firla-Cuchra (2005). This confirms the hypothesis associated with the benefits of diversifying the asset pool for the risk premium demanded, and the hypothesis that lower liquidity premiums are demanded in higher-volume issues. In short, the size of a bond issue has a twofold negative influence on the risk premium demanded: firstly through the direct effect observed on both *YieldAAA* and *YieldAVE*, and secondly through the indirect effect of generating more tranches on *YieldAAA* (weak effectiveness of tranching), though the latter is observed only in the pre-crisis period.

5. Conclusions

Based on the analysis of 1,959 Spanish ABS and MBS issues (from 1993 to 2011), we can conclude that the generation of a greater number of tranches is associated with achieving more complete markets (particularly regarding the senior segments) and the reduction of the moral hazard problems, with the generation of additional tranches being seen as a necessary cost to offset the risk perceived by investors.

In addition, the primary yield offered by securitisation bond issues, when designed to be placed effectively and competitively on the markets, can be satisfactorily explained by specific factors of the securitisation issues such as the degree of complexity associated to the internal architecture of the issue and the size of the credit portfolio.

It can be concluded that multi-tranche structuring is an efficient (but limited) tool for placing securitisation issues with more competitive yields. It is clearly conducive to a lower risk perception among senior investors, so weak effectiveness of multi-tranche structuring must be accepted (zero-sum game), but it does not reduce the overall risk perception on the part of investors as a whole, so strong effectiveness of multi-tranche structuring cannot be accepted.

The size of issues also has a favourable influence on the yield of securitisation bonds: the bigger they are, the lower the yield demanded is. That influence can be explained by at least two factors: diversification of risk and increased liquidity. Size also has an indirect effect on yield via the generation of a larger number of tranches.

The sub-prime crisis created a profound disturbance in the securitisation bond market in Spain and prevented the effective placement of bond issues on primary markets. The fact that securitisation bonds issued from summer 2007 onwards were not market oriented does away with the link between the complexity of issues and the yield offered on them. Thus, tranching ceases to be an effective tool in the design of such issues and the yield that they offer is no longer a real measurement of their risk. We therefore believe that the informational power of the differentials offered on securitisation bonds is limited mainly to the yield of the senior tranches issued in the pre-crisis period, i.e. to those issues that were in fact designed to be placed on markets competitively.

At the same time the particular design of securitisation operations in Spain, characterised by equity tranches being held back by the originators (CNMV 2010), may well have helped to align the objectives of credit institutions (originators) with those of investors but it also meant that credit institutions built up a credit risk that was excessive for the volume of financing obtained, a fact whose consequences they are now suffering.

Accordingly, we believe that conditions must be sought which can lead to an optimum point where a significant part of the equity tranches of issues are placed effectively on the market without incurring too great a misalignment between issuers and investors, or for ensuring that the distribution of risks distributed and held back by the originator is representative of the risk distribution associated with the tranches of an issue as a whole. We argue that the withholding by originators of similar percentages of the different tranches issued could help assure more efficient, more complete markets where the informational power of the yield offered by securitisation bonds is greater.

Notes

1 Securitisation Data Report Q2-2012 - Association for Financial Markets in Europe (2012).

2 The generation of high-quality bonds is supported by the flexibility associated with this financial technique, which enables issues to be structured into several differentiated series of bonds subordinated one to another. This means that certain subordinate (or "equity") tranches take up most of the risk, thus releasing other "senior" and making it easier for them to obtain the highest ratings.

3 However it is mainly the originators themselves who hold on to most risky series (equity tranches), in line with US and European regulations, which require the withholding of the equivalent of 5% of the total risk (Guo and Wu, 2014; Benendo and Bruno, 2012).

4 Ashcraft and Schuermann (2008) detail the frictions associated with information asymmetries in the securitisation chain and indicate that, according to Moody's, the standard of management by those responsible for fund may influence actual losses by as much as 10%.

5 In spite of the controversy sparked in the wake of the subprime crisis as regards the reliabilty of ratings, most studies opt to use the average rating awarded by CRA as an *ex ante* proxy to measure risk in issues, so it can be considered as a correct indicator of inherent risk (Bodenstedt *et al.*, 2013; Rösch and Scheule, 2012).

6 In regard to fund diversity, all securitisation issues in Spain take place with a single type of collateral. Therefore for each type of collateral (dummy variables are used to identify them) the main form of fund diversification is size, as the greater the volumen is the more extensive the geographical, demographic and activty base of the original loans is. The size of securitisation funds can be larger for eitehr of two main reasons: (1) because the organisation involved is large and operates in a large number of territories, sector sor markets (in these cases the loan portfolio comes from a single organisation), or (2) because the loan portfolio transferred to a securitisation fund contains loans assigned by many financial organisations. Both lead to the same result: graeter diversification of the portfolio through greater size.

7 FTA-CM = Multi-seller asset securitisation funds. These funds are excluded because of these specific characteristics: (i) they are the only backed not by a specific pool of assets but instead by all the mortgage-backed

assets of the originator; (ii) they are the only onces that offer a constant coupon in the majority of cases; (iii) they are not set up on the basis of multi-tranche structures; and (iv) they do not generate series of bonds with clearly differentiated yield/risk profiles, as evidenced by the fact that they always obtain the highest (AAA/Aaa) rating. FTA-CM are therefore considered as atypical securitisation structures (Carbo-Valverde *et al*, 2015; Caterineu and Pérez, 2008).

[8] Because in these cases the primary yield of the securitisation bonds issued in association with such funds, measured as the differential in regard to the benchmark interest rate, is only known at the time of their setting up and not at any time subsequent to their issue. It must be noted that not counting FTA-CM only 6 such funds werer set up, for a total amount of 4,873 millions of euros.

[9] The protection effect generated by junior tranches cannot be observed in securitisation funds with a single tranche because there are no junior tranches. Not counting FTA-CM and funds that do not offer variable yield, only 27 ABS and MBS-type single-tranche funds were set up with prívate credit institutions as their originators, for a total amount of 19,283 millions of euros.

[10] The design of securitisation operations in Spain has been subordinated to the interests of wholesale investors, present in the process of negotiation and setting up conditions –road shows prior to issues– which prioritise the acquisition of riskless bonds (though they may offer a low yield premium) rather than more speculative bonds, which are generally held back by the originators as a sign of quality (Uhde & Michalak, 2010). This has led to an effort to maximise the relative weight of AAA tranches in Spain .

[11] This variable is used to divide the population and thus assess the moderating effect of the crisis on the phenomenon analysed.

[12] Thus, one variable (in our case *Ntranches*) can act as an explanatory (or independent) variable in regard to the yield of issues (*YieldAAA* or *YieldAVE*) and at the same time as a variable to be explained.

[13] The results of the Mann-Whitney U test shows that on average YieldAVE exhibits lower levels in the pre-crisis period (Mn = 21.01, Mdn = 20.00, SE = 9.79) than during the crisis (Mn = 51.07, Mdn = 42.00, SE = 27.95, U = 2178, p-value < 0.01, r = -0,7971). Similarly, YieldAAA also exhibits lower levels in the pre-crisis period (Mn = 16.92, Mdn = 15.00, SE = 10.10) than during the crisis (Mn = 39.74, Mdn = 30.00, SE = 25.81, U = 2900, p-value < 0.01, r = -0.7801).

[14] Paradoxically, in 2008-2011 the yield premium associated with the bonds with the worst categories (lowest ratings) were, on average, lower than those for 1993-2007, whereas in categories with ratings higher than Baa3/BBB the yield premium (differential) in 2008-2011 was higher than in 1993-2007.

[15] Other control variables linked directly or indirectly to risks for issues (and issuers) and to the quality of the ratings awarded are the following: Nrating (Number of rating), Guarantee (offered by a public institution), Types of Collateral, Types of originator, Nissuers (Number of issuers or originators), etc.

[16] As a further analysis to validate the model a simple cross-validation is carried out by splitting the data into two subsets. In particular, we have chosen to carry out two types of simple cross-validation. First, the population analysed was randomly divided into two subsamples, with the adjustment level (R^2) of the debugged models (4, 8, 12 and 16) in both samples being calculated. It is observed that in the pre-crisis period the stability of the models is acceptable (maximum difference in R^2 lower than 4.5%), while in the post-crisis period the model loses stability (maximum difference in R^2 higher than 14%). Second, the population analysed is randomly divided into two subsamples: training sample vs. test sample, with each of the four debugged models in the training sample being tested and the coefficients obtained being saved. Subsequently, using these coefficients, the expected value of the dependent variables in the sample test is calculated and compared with the observed values. From these two series (observed values vs. estimated values) the Pearson correlation coefficient (r) is obtained. Following this second method, similar results are obtained: in the pre-crisis period the stability of the models is acceptable (maximum difference in r less than 6%), while in the post-crisis period the model loses stability (maximum difference in r greater than 20%).

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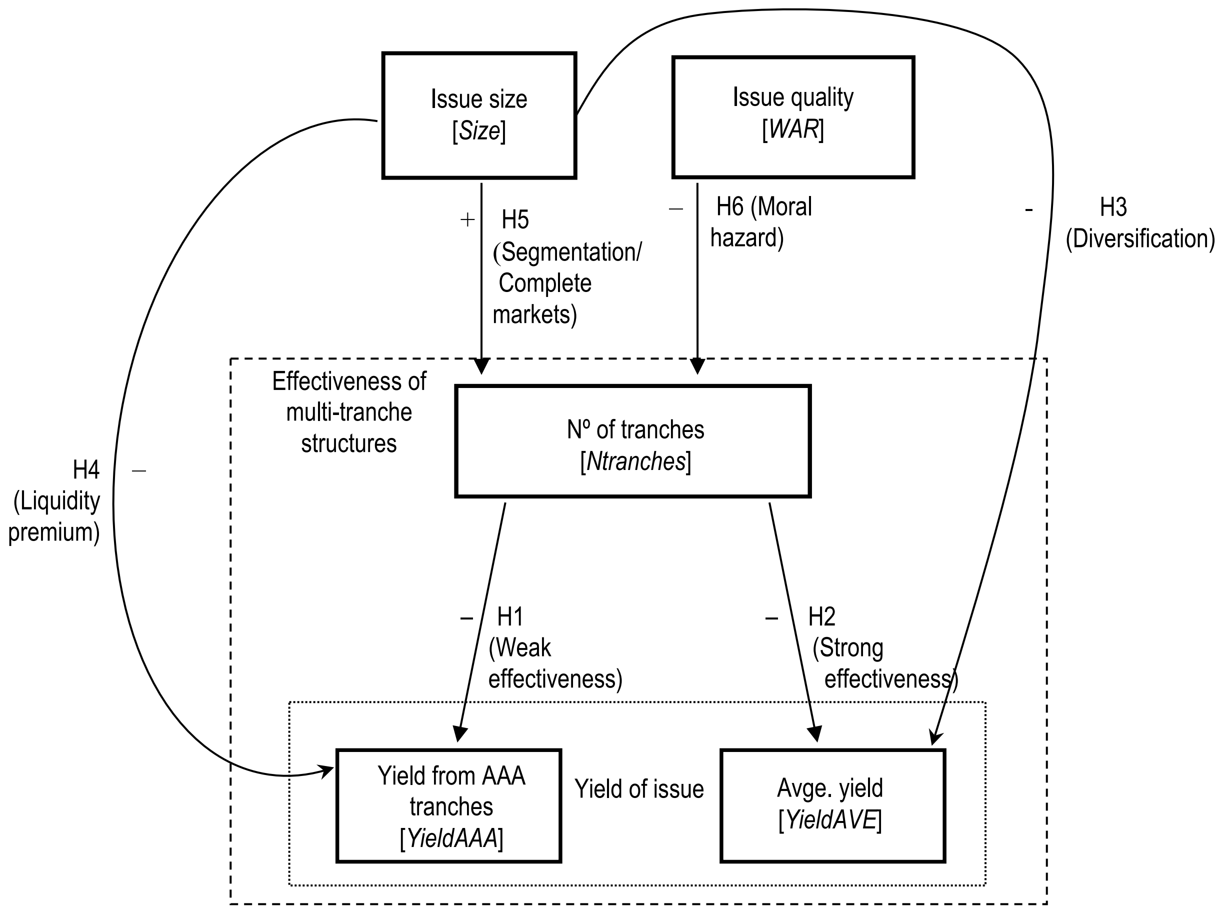
Figure 1. Explanatory model proposed for number of tranches and yield of securitisation bonds.



Note: This graphic only shows the relationships envisaged in the research hypotheses proposed.

Table 1. Distribution of the securitisation funds studied here, classed by the time when they were set up. Volume is shown in millions of euros.

TYPE OF FUND	**COLLATERAL**	**Pre-crisis**		**Crisis**		**Total: 1993-2011**	
		Number	Volume	Number	Volume	Number	Volume
MBS	PRIME MORTGAGE LOANS	81	49,446	6	6,443	87	55,889
ABS	MORTGAGE TRANSF. CERT	109	125,059	81	128,179	200	253,238
	ENTERPRISE LOANS	8	14,155	57	87,458	65	101,613
	SME LOANS	62	46,464	32	23,032	96	69,496
	PERS.& CONSUMER LOANS	18	17,623	21	20,596	39	38,219
	LEASING	2	3,000	7	6,980	9	9,980
	PUBLIC ADMIN	2	3,055	0	0	2	3,055
	OTHERS	4	2,500	1	1,682	5	4,182
	TOTAL	**286**	**261.302**	**217**	**274,370**	**503**	**535,672**

Table 2. Statistics describing the measurement variables for each of the two periods analysed.

Variable	Period	N	Min.	Max.	Average	St. Dev.
YieldAVE	Pre-crisis	286	4.00	46.00	20.39	6.54
	Crisis	217	20.00	165.00	47.46	6.61
YieldAAA	Pre-crisis	286	0.00	40.00	16.28	19.58
	Crisis	217	6.00	100.00	35.85	14.10
NTranches	Pre-crisis	286	1.1 (2)[a]	2.48 (11)[a]	1.56 (4.04)[a]	0.34 (1.79)[a]
	Crisis	217	1.1 (2)[a]	2.64 (13)[a]	1.53 (3.81)[a]	0.27 (1.44)[a]
WAR	Pre-crisis	286	19.50	21.94	21.59	0.315
	Crisis	217	13.50	22.00	20.62	1.447
Subordination	Pre-crisis	286	0,02	0,81	0,07	0,070
	Crisis	217	0,00	0,50	0,14	0,098
NRating	Pre-crisis	286	1.00	3.00	1.79	0.663
	Crisis	217	1.00	3.00	1.38	0.515
Guarantee	Pre-crisis	286	0.00	1.00	0.09	0.217
	Crisis	217	0.00	0.95	0.12	0.257
Maturity	Pre-crisis	286	1.00	53.00	30.36	10.12
	Crisis	217	8.00	53.00	35.72	11.99
Size	Pre-crisis	286	2.89 (18)[b]	8.52 (5.000)[b]	6.54 (913)[b]	0.808 (677)[b]
	Crisis	217	4.61 (100)[b]	9.05 (8.500)[b]	6.74 (1.264)[b]	0.91 (1.343)[b]
B10	Pre-crisis	286	-90.30	217.7	116.38	73.97
	Crisis	217	-81.31	439.3	136.24	190.3

[a] Figures without (with) brackets show the statistics for the Ln-transformed *Ntranches* (non transformed Ntranches) variable.

[b] Figures without (with) brackets show the statistics for the Ln-transformed Size –in millions of euros– (non transformed Size) variable.

Table 3 (1/2). Summary of multiple regression models used to explain Yield AAA and Yield AVE, using Ntranches as mediate variable, incorporated into Path Analysis (SEM). Part I: Precrisis Period.

Depend. Vble.1 / Indep. Vbles	Yield AAA [1]	Yield AAA [2]	Yield AAA [3]	Yield AAA [4]	Bootstrap Interval	Yield AVE [5]	Yield AVE [6]	Yield AVE [7]	Yield AVE [8]	Bootstrap Interval
Intercept	50.582 [35.58]	43.78*** [26.07]	25.97*** [3.487]	30.00 [23.428]	{-32.38, 71.27}	241.32***[39.4]	215.18***[29.51]	26.27***[4.130]	192.76 [26.37**]	{130.75, 265,76}
Ntranches	**-1.731 [1.202]**	**-1.714 [1.201]**	**-1.531 [1.171]**	**-3.052***[0,498]**	**{-5.149, -0.702}**	**1.434 [1.358]**	**1.492 [1.359]**	**3.116**[1.389]**	**0.352 [1,284]**	**{-1.720, 3.194}**
Size	**-1.202**[0.516]**	**-1.213**[0.516]**	**-1.275**[0.509]**	**-1.465***[0.495]**	**{-2.572, -0.317}**	**-1.318**[0.582]**	**-1.353**[0.582]**	**-1.933**[0.603]**	**-1.942*** [0.558]**	**{-3.129, -0.608}**
WAR	-1.188 [1.605]	-0.834 [1.205]	n.e.	0.109 [1.060]	{-1.670, 3.032}	-10.02***[1.813]	-8.816***[1.363]	n.e.	-7,329*** [1.194]	{-10.68, -4.471}
Subord.	-2.078 [6.181]	n.e.	0.958 [4.598]	n.e.	n.e.	-7.049 [6.984]	n.e.	18.54***[5.453]	n.e.	n.e.
Nrating	-0.758 [0.567]	-0.760 [0.569]	-0.806 [0.565]	-0.652 [0.582]	{-1.725, 0.538}	-0.813 [0.639]	-0.823 [0.642]	-1.223*[0.668]	-0.710 [0.655]	{-1.912, 0.602}
Guarantee	-13.77***[1.98]	-13.99***[1.894]	-14.11***[1.927]	-16.99*** [1.548]	{-20.72, -13.83}	-10.99***[2.24]	-11.71***[2.12]	-13.82***[2.29]	-14.82*** [1.743]	{-18,98, -10,74}
PML	1.328 [1.967]	1.252 [1.954]	0.907 [1.88]	n.e.	n.e.	4.242*[2.216]	3.983*[2.205]	0.691 [2.223]	n.e.	n.e.
MTC	1.482 [1.944]	1.404 [1.929]	1.112 [1.879]	0.962 [0.700]	{-0.407, 2.223}	3.686*[2.177]	3.423 [2.166]	0.571 [2.208]	0.530 [0.788]	{-0.872, 1.885}
EL	0.668 [2.378]	0.695 [2.389]	0.910 [2.368]	n.e.	n.e.	2.233 [2.703]	2.324 [2.718]	4.266 [2.821]	n.e.	n.e.
SME	-1.826 [1.839]	-1.881 [1.833]	-1.998 [1.826]	n.e.	n.e.	1.168 [2.093]	0.984 [2.087]	-0.282 [2.181]	n.e.	n.e.
P&C	0.583 [2.021]	0.541 [2.025]	0.468 [2.020]	n.e.	n.e.	3.094 [2.290]	2.954 [2.294]	2.124 [2.402]	n.e.	n.e.
Maturity	-0.023 [0.038]	-0.023 [0.038]	-0.019 [0.038]	-0.045 [0.033]	{-0.116, 0.024}	-0.059 [0.043]	-0.057 [0.043]	-0.021 [0.045]	-0.063 [0.037]	{-0.149, 0.020}
CB	1.171 [0.986]	1.190 [0.986]	1.217 [0.984]	n.e.	n.e.	0.172 [1.099]	0.235 [1.099]	0.559 [1.151]		n.e.
SB	-0.060 [0.994]	-0.021 [0.983]	0.126 [0.960]	-1.144* [0.637]	{-2.329, 0.130}	-0.873 [1.127]	-0.739 [1.121]	0.695 [1.141]	-1.229* [0.717]	{-2.598, 0.138}
CC	-0.503 [1.440]	-0.471 [1.451]	-0.44 [1.441]	n.e.	n.e.	0.035 [1.631]	0.145 [1.630]	0.568 [1.712]	n.e.	n.e.
FCE	1.659 [1.317]	1.699 [1.309]	1.759 [1.311]	n.e.	n.e.	1.420 [1.498]	1.556 [1.492]	2.258 [1.566]	n.e.	n.e.
B10	0.026***[0.004]	0.026***[0.004]	0.026***[0.004]	-0.020*** [0.004]	{0.013, 0.028}	0.029***[0.005]	0.029***[0.005]	0.026***[0.005]	-0.024*** [0.005]	{0.016, 0.033}
Nissuers	0.078 [0.126]	0.080 [0.126]	0.093 [0.124]	n.e.	n.e.	-0.028 [0.142]	-0.020 [0.143]	0.100 [0.148]	n.e.	n.e.
Innovation	7.531***[2.092]	7.511***[2.094]	7.474***[2.096]	n.e.	n.e.	7.852***[2.365]	7.783**[2.371]	7.374**[2.488]	n.e.	n.e.
Depend. Vble.2 / Indep. Vbles	**Ntranches [1]**	**Ntranches [2]**	**Ntranches [3]**	**Ntranches [4]**	**Bootstrap Interval**	**Ntranches [5]**	**Ntranches [6]**	**Ntranches [7]**	**Ntranches [8]**	**Bootstrap Interval**
Intercept	7.406***[1.671]	6.520* [1.231]	0.707*** [0.172]	8.677***[1.107]	{5.746, 13.061}	7.406***[1.671]	6.520***[1.231]	0.707***[1.107]	8.677***[1.107]	{5.746, 13.06}
Size	**0.089***[0.025]**	**0.088***[0.025]**	**0.074**[0.025]**	**0.087*** [0.025]**	**{0.044, 0.150}**	**0.089***[0.025]**	**0.088***[0.025]**	**0.074**[0.025]**	**0.087*** [0.025]**	**{0.044, 0.150}**
WAR	**-0.311***[0.077]**	**-0.273***[0.057]**	**n.e.**	**-0.368*** [0.051]**	**{-0.568, -0.236}**	**-0.311***[0.077]**	**-0.273***[0.057]**	**n.e.**	**-0.368*** [0.051]**	**{-0.568, -0.236}**
Subord.	**-0.226 [0.305]**	**n.e.**	**0.6**[0.231]**	n.e.	n.e.	**-0.226 [0.305]**	**n.e.**	**0.6**[0.231]**	n.e.	n.e.
Nrating	0.078**[0.028]	0.078**[0.028]	0.069**[0.028]	0.014*** [0.030]	{0.044, 0.162}	0.078**[0.028]	0.078**[0.028]	0.069**[0.028]	0.014*** [0.030]	{0.044, 0.162}
Guarantee	0.228**[0.097]	0.206**[0.093]	0.149 [0.097]	0.463*** [0.076]	{0.266, 0.694}	0.228**[0.097]	0.206**[0.092]	0.149 [0.097]	0.463*** [0.076]	{0.266, 0.694}
PML	0.201**[0.097]	0.193**[0.096]	0.096 [0.095]	n.e.	n.e.	0.201**[0.096]	0.193**[0.096]	0.096 [0.095]	n.e.	n.e.
MTC	0.414***[0.093]	0.406***[0.092]	0.335***[0.093]	0.157*** [0.035]	{0.083, 0.239}	0.414***[0.092]	0.406***[0.092]	0.335***[0.092]	0.157*** [0.035]	{0.083, 0.239}
EL	0.291**[0.116]	0.295**[0.117]	0.374**[0.118]	n.e.	n.e.	0.291**[0.117]	0.295**[0.118]	0.374**[0.119]	n.e.	n.e.
SME	0.422***[0.087]	0.417***[0.087]	0.398***[0.09]	n.e.	n.e.	0.422***[0.088]	0.417***[0.088]	0.398***[0.09]	n.e.	n.e.
P&C	0.166*[0.099]	0.162 [0.100]	0.144 [0.102]	n.e.	n.e.	0.166*[0.100]	0.162 [0.100]	0.144 [0.102]	n.e.	n.e.
Maturity	0.002 [0.002]	0.002 [0.002]	0.003 [0.002]	0.004** [0.002]	{0.000, 0.008}	0.002 [0.002]	0.002 [0.002]	0.003 [0.002]	0.004** [0.002]	{0.000, 0.008}
CB	0.016 [0.049]	0.018 [0.049]	0.029 [0.05]	n.e.	n.e.	0.016 [0.048]	0.018 [0.048]	0.029 [0.049]	n.e.	n.e.
SB	-0.124**[0.049]	-0.12**[0.048]	-0.079 [0.049]	0.020*** [0.004]	{-0.185, -0.048}	-0.124**[0.049]	-0.12**[0.049]	-0.079 [0.049]	0.020*** [0.004]	{-0.185, -0.048}
CC	-0.038 [0.071]	-0.034 [0.072]	-0.022 [0.073]	n.e.	n.e.	-0.038 [0.071]	-0.034 [0.071]	-0.022 [0.073]	n.e.	n.e.
FCE	-0.176**[0.064]	-0.172**[0.064]	-0.158**[0.066]	n.e.	n.e.	-0.176**[0.065]	-0.172**[0.064]	-0.158**[0.066]	n.e.	n.e.
B10	-0.001***[0.000]	-0.001***[0.000]	-0.001***[0.000]	-0.001*** [0.000]	{-0.001, -0.001}	-0.001***[0.000]	-0.001***[0.000]	-0.001***[0.000]	-0.001*** [0.000]	{-0.001, -0.001}
Nissuers	0.007 [0.006]	0.008 [0.006]	0.012*[0.006]	n.e.	n.e.	0.007 [0.006]	0.008 [0.006]	0.012*[0.006]	n.e.	n.e.
Innovation	-0.138 [0.103]	-0.14 [0.103]	-0.161 [0.106]	n.e.	n.e.	-0.138 [0.103]	-0.140 [0.103]	-0.161 [0.106]	n.e.	n.e.
Model fit: χ^2	196.394	171.877	182.863	14.724		194.359	173.274	179.758	14.724	
χ^2/df;RMSEA	2.004; 0.095	2.046; 0.061	2.032; 0.060	1.227; 0.0283		2.160; 0.064	2.221; 0.066	2.192; 0.065	1.227; 0.028	
CFI; GFI	0.964; 0.936	0.964; 0.941	0.961; 0.937	0.996; 0.989		0.960; 0.937	0.960; 0.941	0.957; 0.939	0.996; 0.989	
NFI; TLI	0.932; 0.930	0.934; 0.927	0.928; 0.925	0.982; 0.986		0.931; 0.917	0.932; 0.912	0.926; 0.910	0.979; 0.985	
R^2Yield;	*55.0%*	*55.1%*	*54.9%*	*50.2%*		*40.9%*	*41.3%*	*35.1%*	*34.9%*	
R^2Ntranches	*57.4%*	*57.8%*	*54.3%*	*50.6%*		*57.5%*	*57.7%*	*54.6%*	*50.6%*	

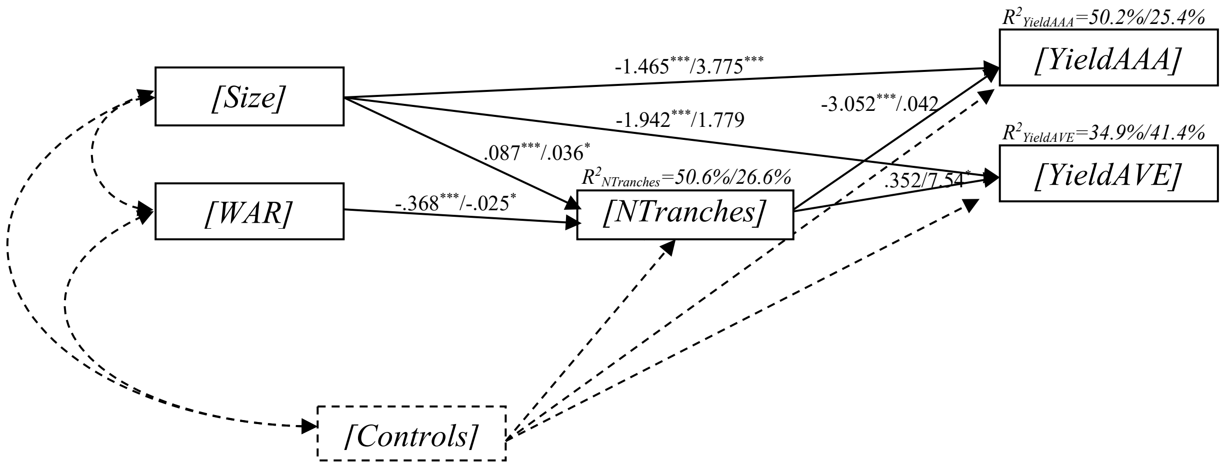
Note: The figure shown in the table for each variable represents the non-standardised coefficient for that variable. The figure in square brackets represents the [standard error]. $^{*;**;***}$denote significance at the 0.1; 0.05; 0.01 levels, respectively. The interval shown in braces represents the {95% bias-corrected confidence interval calculated via the bootstrap method}. Variables used in the regression models: YieldAAA: Triple-A ABS/MBS yield; YieldAVE: ABS/MBS average yield; Ntranches (Ln number of tranches); Size (Ln issue size); WAR (Weighted Average Ratins); Subordination (attachment point); Nrating (Number of rating); Guarantee (by a public institution); Types of Collateral: PML (Prime Mortgage Loans), MTC (Mortgage Transfer Certificates), EL (Enterprise Loans), SME (Small and Medium Enterprise loans), P&C (Personal & Consumer loans); and others; Types of originator: CB (Commercial Bank), SB (Savings Banks), CC (Credit Cooperatives), FCE (Financial Credit Establishments), or a mix of these; B10 (10-years Spanish Bond rate); Nissuers (Number of issuers or originators); Time variables-dummies: Innovation (1: if emission year is 1993-1995, 0: otherwise); Precrisis (if emission year is 1993-I/2007-VIII), Crisis (if emission year is 2007-VIII/2011-XII). Model fit indicators: RMSEA (root mean square error of approximation), CFI (comparative fit index), GFI (goodness fit index), NFI (normed fit index), TLI (Tucker-Lewis index). "n.e.": no entry.

Table 4. Structural Equation Modelling multigroup analysis results. Dependent variables: MBS/ABS AAA issues Primary Yield (YieldAAA) and MBS/ABS issues average Primary Yield (YieldAVE); Mediating variable: Number of tranches (Ntranches); Moderating variable: Crisis. Maximum likelihood estimate method.

Hypotheses	Expected Relationship	Pre-crisis	Crisis	CR for Differences[a] *(Pre-crisis vs. Crisis)*
Dependent variable: No. of Tranches (*NTranches*)				
H5: market completeness	*Size → + NTranches*	0.087*** [0.025] {-0.568; -0.236}	0.036* [0.021] {-0.003; 0.081}	-1.54
H6: moral hazard	*WAR → - NTranches*	-0.368*** [0.051] {-0.568; -0.236}	-0.025* [0.013] {-0.061; -0.004}	6.55***
Dependent variable: MBS/ABS AAA issues Primary Yield (*YieldAAA*)				
H1: weak effectiveness	*NTranches →- YieldAAA*	-3.052*** [0.498] {-5.149; -0.702}	0.042 [3.643] {-6.069; 6.489}	0.81
H4: liquidity	*Size → - YieldAAA*	-1.465*** [0.495] {-2.572; -0.317}	3.775*** [1.136] {1.812; 5.677}	4.23***
Controls		*Included*	*Included*	
$R^2_{\text{Ntranches}}/R^2_{\text{YieldAAA}}$		49.7%/49.9%	26.9%/25.0%	
Model Fit: χ^2=13.36; χ^2/df=1.114; CFI=0.999; GFI=0.995; NFI=0.989; TLI=0.990; RMSEA=0.015.				
Dependent variable:MBS/ABS issues average Primary Yield (*YieldAVE*)				
H2: strong effectiveness	*NTranches → - YieldAve*	0.352 [1.284] {-1.720; 3.194}	7.539* [4.461] {-1.066; 16.100}	1.55
H3: diversification	*Size → - YieldAve*	-1.942*** [0.558] {-3.129; -0.608}	1.779 [1.391] {-0.886; 4.061}	2.48**
Controls		*Included*	*Included*	
$R^2_{\text{Ntranches}}/R^2_{\text{YieldAVE}}$		49.7%/34.1%	26.9%/41.3%	
Model Fit: χ^2=13.36; χ^2/df=1.114; CFI=0.999; GFI=0.995; NFI=0.988; TLI=0.990; RMSEA=0.015.				

Note: The figure shown in the table for each variable represents the non-standardised coefficient for that variable. The figure in square brackets represents the [standard error]. The interval shown in braces represents the {confidence interval calculated via the Bootstrap method}.[a] Critical ratios for differences between parameters (Pre-crisis group vs. Crisis group).$^{*/**/***}$denote significance at the 0.1/0.05/0.01 levels, respectively. The values of the estimators associated with the control variables can be checked in Table 3 (Models 4, 8, 12 and 16).

Figure 2. Explanatory model proposed for number of tranches and yield of securitisation bonds: main coefficient results.



Note: This graphic only shows the relationships envisaged in the research hypotheses proposed (complementary, Table 3 shows the coefficients existing between all the explanatory and dependent variables). The figures shown for each hypothesis represents the non-standardised coefficient for that relation in the Pre-crisis/Crisis period. */**/***denote significance at the 0.1/0.05/0.01 levels, respectively. The figures (*in italics*) shown above the explanatory variables represent the determination coefficient (R^2) for the SEM regression model in the Pre-crisis/Crisis period.