Skin-in-the-Game in ABS Transactions: A Critical Review of Policy Options

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Keywords: Structured finance, ABS, STS (simple, transparent, and standardized securitizations), regulation, retention, Dodd-Frank Act

JEL Classifications: G28

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September 8, 2021

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1 Introduction

The collapse of the securitization markets, particularly in the case of housing loans, marked the onset of the financial crisis in 2007. An unexpectedly low level of credit quality led securitization tranches to be downgraded across the board; their prices fell; and market liquidity disappeared. Aggressive marketing by some US-real estate lenders, who sometimes relied on a poorly qualified sales force motivated by sales bonuses, was widely blamed for the systematic losses in real estate lending. In the wake of the crisis, academic research has found evidence of large-scale missellings in the mortgage market (see, e.g., Keys et al. (2010)) .

An important lesson from the subprime mortgage lending crisis, therefore, is the need to control for originator incentives when designing asset-backed security (ABS) transactions. Incentive problems in securitizations have been widely discussed in the theoretical literature (Cerasi and Rochet (2014)). Without a deductible, that is, a portion of the issue being withheld or retained by the issuer, originators of credit securitizations are neither motivated to engage in proper screening of loan applicants nor interested in monitoring loan recipients over the life of the loan contract. As a remedy to these incentive problems, loan originators should keep the default risk, or parts thereof, on their own balance sheet, that is, they should hold on to some *skin in the game*. Doing so would help to align the incentives of originators with those of investors (see DeMarzo (2005); Franke and Krahnen (2009)).

The regulatory debate prominently addressed incentive issues when, in 2008, the first G-20 summit, held in Pittsburgh, concluded with a plea for worldwide regulation of minimum standards for credit risk retention. The International Association of Supervisors (IOSCO) made a similar argument to advocate for an improved incentive alignment between investors and originators (see IOSCO (2012)).

In the US, the regulation of skin-inthe-game standards are codified in the Dodd-Frank Act (DFA (2010)), with implementation rules specified by the Securities and Exchange Commission (SEC (2014)). In the EU, similar efforts have led to the enactment of CRD IV and CRR (EC (2013)), with implementation proposed by the European Banking Authority (EBA (2016)). In both jurisdictions, existing rules define different forms of risk retention as being compliant with the minimum standard. These options compose a so-called "vertical slice", the same percentage of all issued tranches, and a "horizontal" first loss slice as the two basic options. A linear combination of these basic options is permitted under the DFA rules, while further options are eligible under the CRR in Europe, including a random selection from an underlying pool of assets of similar qualities.

Several questions arise: Which options exist for the fulfillment of the retention obligation? Which retention options are actually chosen by issuers of securitization transactions, and is the required retention level just being met or is it even exceeded? Are these options comparable in the sense that they imply the same amount of risk retention? More generally, can investors assess the amount of retained risk from the information that is disclosed under the present regulations in the US and the EU?

To answer these questions, we take a look at the implementation of these retention rules in the US and in the EU, and assess whether the 5% rule allows for a proper risk assessment and comparison across options, and whether it is binding in Europe, as it has recently been shown to be for the US (Flynn et al. (2020); Furfine (2020)).

Based on a sample of European qualified STS securitization transactions (simple, transparent, and standardized), we make three observations. First, issuers have different options to choose from in order to comply with the existing retention regulation, and most options tend to be chosen by issuers. Second, for the same transaction, different options imply different levels of expected default loss retention. Third, the 5% nominal retention minimum is surpassed in a large part of the sample. Taken together, these findings suggest that investors cannot infer the effective risk retention from merely knowing that issuers comply with the 5% rule.

Despite the extensive regulation of securitization transactions, the ABS market remains opaque concerning risk retention. To lessen opacity, and thus reduce information costs, the disclosure of effective retention would be helpful, and we will propose a suitable and intuitive metric in Section 3.1.

We then use the metric to compare legally permissible retention formats. We find that actual risk retention varies significantly across formats and between retention levels. From an investor's standpoint, this degree of variability suggests some room for informational improvement. The proposed retention metric, $\mathcal{RM}$, suitably improves investor's information, in comparison to knowing the retention format only. Thus, an alteration to the current regulation should ensure full disclosure of the effective retention level, rather than requiring a fixed nominal retention level.

The paper is organized as follows. In Section 2, we revisit the theoretical and empirical literature on ABS and give an overview of the current regulation and the various retention specifications it offers. We also provide an empirical analysis of retention in securitizations.

In Section 3, the retention metric, $\mathcal{RM}$, is proposed as a measure for effective retention. The metric is then used to compare among legally permissible retention formats. Section 4 discusses the implications of our findings for the design of ABS regulatory policy and for the disclosure requirements for credit securitizations.

2 Risk retention (skin-in-the-game) as a key characteristic of asset-backed securities

The retention of risk is widely viewed as the key to aligning the interest of issuers and investors in securitization transactions. In this section, we review the literature (2.1), discuss regulatory norms (2.2), and provide empirical evidence (2.3) on risk retention in the US and in Europe. We discuss the following central question: how much transparency about risk retention can be expected in today's securitization markets?

2.1 Risk retention in the literature

The market for asset-backed securities has increased sharply since the mid-1990s, along with an interest in the theory of structured finance. The early (pre-crisis) literature focused on the statistical properties of asset-backed securities, resulting from the pooling and tranching of debt assets, like mortgages and corporate loans, or credit card loans. The newly created securities are characterized by different levels of seniority implying different risk characteristics (Coval et al. (2009); Franke and Krahnen (2007); Krahnen and Wilde (2006)).

The theoretical literature on loan sales and securitization goes back to Diamond (1984), who emphasizes the benefits of borrower screening and monitoring for the repayments of loans. Loan sales, as a consequence, have to deal with the potential loss in value that follows from a separation of the origination of the loan from its holding as an investor (Gorton and Pennacchi (1995)). One way to reap the benefits of diversification and liquidity when there is adverse selection risk is to bundle several loans in a portfolio and subsequently apportion the portfolio proceeds to securities that are subordinate to one another, ranging from an equity piece to a senior tranche. Incentive compatibility is reached when control rights are given to the holder of the most junior securities (Riddiough (1997)).

In DeMarzo (2005), the tranching of cashflows into different securities allows one to create information-insensitive securities, that is, senior bonds, that are liquid and can be sold to uninformed investors. The information-sensitive tranche, in contrast, rests with the professional investors and intermediaries. The basic feature of first loss retention is shown to be optimal in a hidden information setting when the underwriter receives payoff after other claim holders have been paid off (Hartman-Glaser et al. (2012)). Cerasi and Rochet (2014) embed the role of first loss retention in a simple Holmström-Tirole model. They find that monitoring incentives are preserved if and only if a sufficiently large junior tranche is retained. Fender and Mitchell (2009a) draw on a screening model in which retention size serves as a signal. They conclude that the full disclosure of retention size may be an alternative to specifying minimum retention sizes. Chemla and Hennessy (2014) model a situation of asymmetric information in which mandatory retention with several options of what to retain dominates a situation without government intervention.

Since, in principle, retention can be achieved different ways, for example, by taking a share of each tranche (vertical retention) or by taking a chunk of a single tranche (horizontal retention), one could ask whether all forms of retention are alike, provided they have the same nominal magnitude. Malekan and Dionne (2014) show in a principal-agent model with moral hazard that this is not so: horizontal risk retention, that is, first loss retention, dominates vertical forms of risk retention with respect to its incentive effect unless default risks across firms are highly correlated, as in situations of systemic risk. See also Fender and Mitchell (2009b).

Most empirical work on US and European ABS has bypassed effective retention, owing to the lack of disclosure, and has instead looked at the size of the first loss piece, basically assuming retention. Haensel et al. (2006), who equate retention with the first loss piece, find retained risk to exceed the issue's expected loss by an average of +50%, in a sample of 39 European CDO transactions issued between 2002 and 2006. For these issues, the allocation of the junior-most tranche, the so-called "equity piece", determines the effective risk transfer from banks (as originators of the pooled loan assets) to capital markets (e.g., institutional investors). Significant risk transfer, therefore, would require selling at least part of the first-loss piece to outside investors.

A lot of empirical work has tackled the performance of asset-backed securities since the outbreak of the financial crisis in 2007; Ashcraft and Schuermann (2007) describe the ABS market in detail. Keys et al. (2010) find evidence of a negative impact of securitization (likelihood) on ex-ante screening efforts by the issuer. Begley and Purnanandam (2013) and Ashcraft et al. (2014) both find additional support for the risk mitigation hypothesis of retention.

Begley and Purnanandam (2013) rely on 163 securitization deals with more than 500,000 underlying residential mortgage loans over the period 2001-2005. They find an inverse relationship between the size of the equity tranche and the level of foreclosure experienced among borrowers in the asset pool. Based on 483 CMBS deals issued between 1995 and 2010, Ashcraft et al. (2014) similarly find the probability of senior tranche default to be inversely related to the size of the first loss piece.

Benmelech et al. (2012) analyze whether securitization is associated with more or less corporate risky lending. They compare two data sets with largely similar loan portfolios, one of which is transformed into a collateralized loan obligation (CLO), whereas the other is not. They find that adverse selection problems are not more severe in the CLO sample. In a horse-race exercise, securitization does not help in predicting default. The authors explain this (negative) finding, which they say is in disagreement with commonly held beliefs in the literature, as the result of a strong reputational mechanism inherent in the syndication process.

Kara et al. (2015), in a difference-in-differences exercise using euro-denominated syndicated loans, find evidence in favor of a more general quality deterioration hypothesis, where the quality of securitized loans deteriorates more than an otherwise identical sample of non-securitized loans. The authors interpret their finding as evidence of the incentive effect of loss retention.

The empirical literature discussed so far does not rely on actual retention data, but rather avoids making any statement on the allocation of actual tranche holdings. Only recently, have data about actual retention decisions of issuers become available.

In one study, Furfine (2020) corroborates the impact of actual retention on the pricing of asset-backed securities in the US. The study relies on a difference-in-differences estimation and shows for a set of CMBS products that the introduction of the mandatory DFA risk retention requirement has led mortgages to be issued at significantly higher yields, lower loan-to-value ratios, and higher income-to-debt-service ratios. Together with the fact that loans subject to risk retention requirements tend to have lower default experiences, these findings suggest that the risk retention rule increases loan value by making loans less risky, in comparison to an otherwise comparable issue without retention.

In another recent study, Flynn et al. (2020) test a linear pricing model in which the retention type, as defined in the Dodd-Frank Act, is the key explanatory variable. They identify a significant pricing premium, particularly for mezzanine tranches, when the first loss piece is retained as opposed to a vertical or hybrid retention. The authors argue their finding is consistent with the market's response in a signaling game in which the retention decision allows the issuer to communicate credibly with the market. According to the authors, the choice of a retention form signals different degrees of monitoring effort by the originator.

Interestingly, both studies rely on US data and find the minimum retention requirements to be binding, suggesting that absent regulation, issuers would rather choose lower retention levels than those prescribed by the law. The evidence differs from what we find in the next section for a sample of European issues that belong to the class of STS (simple, transparent, standardized) loan securitizations, established in 2019 and regulated as a separate asset class according to EU regulation 2017/2402.

Overall, the literature shows the importance of incentive issues in securitizations. Regulators worldwide have responded by defining retention requirements accordingly, thereby requiring originators to have a minimum level of skin in the game. Before exploring the European evidence in greater detail, we will evaluate the existing regulatory rules in the US and the European Union in Section 2.2, where we will focus on risk retention.

2.2 Retention regulation: EU capital regulation and US Dodd-Frank Act

Motivated by the experiences during the 2007-2008 financial crisis, and in accordance with the emerging academic literature on the sources of the systemic risk event in those years, regulators worldwide have tried to counter the observed loss of asset qualities in securitization processes with appropriate regulation.

Accordingly, the official closing document of the September 2009 G-20 Summit in Pittsburgh, the G-20 Leaders' Statement, included a pledge concerning the regulation of skin-in-the-game in ABS markets (see G-20 (2009), paragraph 12): "Securitization sponsors or originators should retain a part of the risk of the underlying assets, thus encouraging them to act prudently".

The Leaders' Statement defines a large set of basic rules for enhanced banking and financial market regulations that were drafted and later enacted, soon after in the US (Dodd-Frank Act 2010) and in the EU (Regulation EU 2013/575). A minimum level of retention by the originator or some other controlling party, like the deal servicer, became a key element relating to securitization markets in both laws.

For example, the relevant EU regulation states: "It is important that the interests of undertakings that 'repackage' loans into tradable securities and other financial instruments (originators or sponsors) and undertakings that invest in these securities or instruments (investors) are aligned. To achieve this, the originator or sponsor should retain a significant interest in the underlying asset." (see EC (2013), p. 8, clause 57).

In both regulations, the intention behind mandatory retention is to ensure a lasting alignment of interest between investors and originators, thereby mitigating adverse selection and moral hazard. Material loss participation by the originator or sponsor is seen as the crucial component in securitization regulation.

The relevant regulations are the Dodd-Frank Wall Street Reform and Consumer Protection Act in the US (see DFA (2010), Title IX, Subtitle D) and the Capital Requirement Directive in the EU, CRR/CRD IV (see Article 405 in EC (2013)). These two regulations are quite similar in spirit, though not identical in the specifications of what the term "retention" actually means. In the Dodd-Frank Act (henceforth DFA), Title IX handles "investor protections and improvements on the regulation of securities", with subtitle D dealing with "improvements of the asset-backed securitization process" (DFA Sections 941-950). Section 941 specifies the regulation of credit risk retention. Implementation provisions have been defined by the SEC in 2014 (see SEC (2014)).

The new rules allow for several different ways to fulfill the 5% retention requirement. The "Final Rule" defines a menu of three options, including the two basic forms of vertical and horizontal retention rules. The implementation rule just cited defines a list of exemptions, largely related to the treatment of securities that enjoy government backing, for example, from government-sponsored entities (GSEs; see p. 533). The three eligible options are as follows:

(a) *Retention of no less than 5% of the fair value of each of the tranches sold or transferred to the investors (vertical piece)*

(b) *Retention of a horizontal piece, starting from the first loss, until no less than 5% of the fair value of the total transaction is reached*

(c) *Retention of linear combination of a vertical and a horizontal piece, summing up to no less than 5% of the fair value of the total transaction*

The relevant implementation regulation in the EU was drafted by the European Banking

Authority in its Regulatory Technical Standards on the Retention of Net Economic Interest and Other Requirements Relating to Transferred Credit Risk, EBA/RTS/2013/12, which was later, after extensive consultations with industry and the public, relaunched as the EBA/RTS/2018/01, the Final Draft Regulatory Technical Standards, specifying new rules for retention. The RTS draws on Regulation EU 2017/2402, the framework of harmonized European rules for simple, transparent, and standardized (STS) securitizations. The European regulation stipulates in Article 405 of the Capital Requirement Directive as follows (see EC (2013)): *Only any of the following qualifies as retention of a material net economic interest of not less than 5%:*

(a) retention of no less than 5% of the nominal value of each of the tranches sold or transferred to the investors;

(b) in the case of securitisations of revolving exposures, retention of the originator's interest of no less than 5% of the nominal value of the securitised exposures;

(c) retention of randomly selected exposures, equivalent to no less than 5% of the nominal value of the securitised exposures, where such exposures would otherwise have been securitised in the securitisation, provided that the number of potentially securitised exposures is no less than 100 at origination;

(d) retention of the first loss tranche and, if necessary, other tranches having the same or a more severe risk profile than those transferred or sold to investors and not maturing any earlier than those transferred or sold to investors, so that the retention equals in total no less than 5% of the nominal value of the securitised exposures;

(e) retention of a first loss exposure not less than 5% of every securitised exposure in the securitisation.

Thus, both regulations, DFA and CRR, offer a menu of implementation options for the fulfillment of the 5% retention requirement. In the documentation for the Dodd-Frank Act, and similarly in the SEC final rule, no clear rationale is provided for the basic set of retention options included in the law, except that they "reflect market practice in asset-backed securitization transaction" (SEC final rule 2014, p. 15).

To understand market practice, one can think of the different intentions behind asset securitization. For example, a deposit-taking bank that is subject to capital regulation may use loan securitization to secure capital relief from its regulator, thereby gaining the opportunity to expand its loan business beyond what it could achieve without securitization. The bank will prefer a vertical slice, which allows it to sell high risk weight junior securities.

In contrast, a corporate ("car leasing") bank, whose primary objective is to provide funding for the mother corporation, will use the securitization of its accounts receivable ("leasing claims") to fund its asset pool. It will prefer to hold a horizontal tranche, which will maximize the size of the "cheap" senior tranche that provides the funding.

The US regulation offers three base options, whereas , the EU regulation offers five options . The most basic options are the "vertical" and the "horizontal" retention of a 5% stake. The terms "horizontal" and "vertical" refer to Figure 1, where tranches of different seniority are stacked one above the other. Vertical retention implies withholding a percentage of each tranche, ranging from the first loss piece to all mezzanine tranches, and the senior-most tranche. For example, by retaining 5% of each tranche, overall retention equals 5% of the issue volume and fulfills the regulatory requirement. Horizontal retention, in contrast, refers to withholding the junior-most tranche and, if needed, the junior-most mezzanine tranche, followed by the second-most junior mezzanine tranche, etc., until the retained issue volume reaches the 5% threshold.

Similarities and differences are observed between these two regulations. As to the similarities, both regulations stipulate the same numerical minimum retention level of 5%, and prohibit the transfer of retained interest to third parties, or the hedging of that particular risk exposure.

As to the differences, several deserve mention. First, the US rule is based on a fair value calculation, whereas the EU rule relies on face values. The fair value of a financial instrument is guided by principles developed within the US-GAAP and in the IFRS framework along similar lines (see IFRS (2013)). Since fair values are closely related to the risk of a particular tranche, securitization tranches typically trade at a discount, and the discount is largest for subordinate tranches. Thus, any fixed minimum retention requirement, say 5%, typically entails higher risk withholding under fair value accounting in contrast to nominal value accounting, in the case that the retention requires withholding a relatively larger share of the riskiest piece (like horizontal retention). A 5% retention based on junior tranche fair values implies larger effective default risk retention than under an otherwise identical regulation based on face values. Therefore, as far as regulatory standards are concerned, the US regulation is stricter than the regulation in the EU for the same transaction.

Second, DFA allows for a linear combination of vertical and horizontal retention , as long as the combination fulfills the 5% requirement. There is no such combination option under European law. Rather, originators or sponsors have to select but one option from the offered set.

Third, apart from the basic retention models "horizontal" and "vertical", the EU rule allows for additional retention models, that is, randomly selected on-balance sheet assets, a 5% retention of each individual underlying exposure in the case of revolving exposures, and a 5% first loss piece of each asset. The first of these options, the randomly selected asset pool, was initially included in the US legislation, but the SEC eventually dismissed it in its final implementation ruling as being prone to poor incentive alignment and "cherry picking" assets (SEC Final Rule on Credit Risk Retention 2014, p. 139). The responsible authority in Europe, the European Banking Authority EBA, has issued detailed rules to ensure randomness in the selection of securitized assets and their allocation to the first loss tranche, in order to mitigate adverse selection.

Further differences between the US and EU regulations refer to tranching (the US regulation also applies to single tranche securitizations, while the EU regulation does not), marketability (the US regulation only applies to securities, while the EU regulation also applies to warehousing schemes), synthetization (the EU regulation also allows to comply with the retention of synthetic instruments, while this is not possible under DFA), squared transactions, and re-securitizations (such transactions are prohibited under EU law).

Finally, and perhaps most importantly, in both cases, DFA and CRR, exemptions, the list of which is long and detailed in the case of the US, can be made to the retention rule (see SEC (2014), pp. 282-562). Under the SEC final rule on credit risk retention, the sponsor has to reveal all input parameters required to calculate the fair value of the transaction and its tranches, including the relevant estimates of loss given default and default risk (pp. 75-82). Under the EU regulatory standards, the identity of the retainer has to be disclosed, as well as the option selected, from (a) to (e), and a re-confirmation of factual retention, at least annually (Art. 23, p. 23). Broader disclosure obligations have been included in the 2017 EU regulation to define STS securitizations.

In the EU, supervision is allocated to national competent authorities, who should receive the necessary powers to supervise, investigate and sanction these securitization rules. The responsible authorities have approved two privately organized Third-Party Verifiers for carrying out the compliance work concerning STS securitizations: Prime Collateralised Securities (PCS), a non-profit entity owned by the 50 largest banks and insurance companies in Europe, and STS Verification International (SVI), a fully-owned subsidiary of True Sale International (TSI) in Germany. Surprisingly, the exact level of the retained interest for a particular securitization is not among the data officially recorded. For further details on the verification process, see ESMA (2021).

As far as disclosure is concerned, the verifier agencies just mentioned produce a template containing the relevant details about the securitization transactions based on the offering circular and further discussions with the issuing institutions. The European Securities and Markets Authority (ESMA) collects the templates for all transactions falling under the STS regulation. The details about the transactions are offered to the public via the European Statistical Data Warehouse. For example, concerning the random selection option (c), detailed prescriptions ensure assets are randomly assigned to the securitization portfolio. Moreover, the identity of securitized loans is back-office information not disclosed vis-à-vis front-office loan officers. Both features should mitigate moral hazard in option (c). However, reported information is not screened or examined, and an enforcement mandate does not exist. Thus, compliance is difficult to audit and is, ultimately, based on trust and the reputation of the issuing institution.

The take away from this section is this : First, since retention is defined in money terms — fair values in the US and face values in the EU — *not* in terms of the risk contained in the respective tranches, the possibilities for investors to apprehend the effective retention of default risk is limited. Second, across retention options acceptable under the respective regulation, the effective risk retained may differ not only between the permitted options, but also between the US and the EU. Therefore, some commentators (see Sweet et al. (2019)) argue that compliance with both regimes simultaneously may be difficult to achieve. This difficulty speaks to the relevance of the regulatory rules beyond the home market. For example, European issuers who want to access the US investor base need to fulfill the 5% rule not only in nominal terms but also in fair value terms.

2.3 Empirical results on retention in the EU and the US

As mentioned earlier, the studies performed by Flynn et al. (2020) and Furfine (2020) provide empirical evidence on the choice of retention options and the retention amount for the US. Both studies find that the retention rules in the US are binding.

To provide comparative evidence for the EU under the new regulation, we refer to the list of STS securitizations as recorded by the European Securities and Markets Authority (ESMA). In the EU, ESMA recorded a total of 446 STS securitizations during the period of March 22, 2019, to January 27, 2021. Of these securitizations, 185 are public transactions and 261 are private transactions. For the private transactions, retention information is not available. The public transactions are all non-ABCP transactions, originating from different EU countries. Of the 185 public transactions, 65 transactions are UK-originated transactions, for which official retention information is not available through ESMA, who is no longer covering this information due to the Brexit.

Thus, our final sample consists of 120 public remaining-EU STS transactions. For these transactions, we manually extract information on the chosen retention option from the official mandatory filings for STS securitizations made available through ESMA, and we manually extract information on the retention amount from the offering circulars. Of these 120 transactions, in three cases, the mandatory template is filled in insufficiently so that the chosen retention option is unclear. In 117 cases, the chosen retention option is clear. Exact information on the retention amount could be extracted manually from 72 offering circulars. Overall, this leaves us with a sample of 117 transactions in which the chosen retention option is known, and, for 72 of these transactions, we also know the retention amount. The fact that retention size is not explicitly documented in official sources but had to be manually collected, is noteworthy, given that retention disclosure is supposedly a key aspect of retention regulation.

The results for the chosen retention options in the EU and the US are presented in Table 1. Under both legislations, the most prominent retention option chosen is horizontal retention (61.5% of all transactions in the EU, 46.8% in the US). Vertical retention is chosen in 18% of all transactions in the EU and in 43.4% of all transactions in the US. In the US, retention of an L-shaped slice (option DF(c)) is chosen in 9.8% of all transactions. In the EU, option EU(c) (retention of randomly selected exposures) is chosen in 20.5% of all transactions, while options EU(b) and EU(e) are not chosen at all.

The results for the retention amount (retained portion) in the EU are presented in Table 2 and Figure 3. For the 72 transactions in the sample, the mean retained portion is 9.1% of the nominal value, and the median is 7%. Both values are well above the retention level of 5% of the nominal value required by the regulation. A breakdown of the retained portion by the chosen retention option shows that the retained portion is always 5% in the case of option 1 (vertical retention); it is slightly greater than 5% in the case of option 3 (retention of randomly selected exposures); and it is substantially greater than 5% in the case of option 4 (horizontal retention), with a mean of 10.4% and a standard deviation of 7%. The size distribution of observed values in all transactions in Figure 3 shows that only in 31 of 72 transactions, is the retained portion close to 5%. These results imply that the 5% retention rule does not seem to be binding for most transactions in the EU.

This finding stands in contrast to previous research for the US documented by Flynn et al. (2020) and Furfine (2020), who find that the US retention regulation is binding. To allow for a comparison with the EU, we report the numbers for the US in Table 2, Panel B. For all transactions, no matter which retention option is chosen, the retained portion is very close to 5% of the fair value as required by regulation. The retained portion is exactly equal to 5% for all transactions involving vertical slice retention, and the average retained portion is only slightly greater than 5% for transactions involving horizontal or L-shaped retention. In fact, among the 226 US transactions, the transaction with the highest retention amount overall is a transaction involving horizontal retention, and it has a retained portion of just 5.22% of the fair value. Thus, virtually all securitization transactions in the US sample are structured in a way that they just meet the retention requirements.

The descriptive study of the European and the US securitization markets provides several insights: First, several retention options (not just one) are frequently chosen in the empirical sample, including vertical slice retention, horizontal slice retention, L-shaped retention, and retention of randomly selected exposures. Second, while the retention amount in the US is typically close to the regulatory requirement of 5%, the retention amount in the EU is well above 5% in many cases.

Taken together, these results show substantial opacity in the retention option chosen and regarding the retention amount in a particular transaction. Evidently, several retention options are chosen, and the retention amount often varies. Thus, simply knowing that the retention requirements are being met for a particular transaction does not provide full information on the extent to which default risk is retained by the issuer. The retention options do not imply the same effective retention (5% horizontal retention is very different from 5% vertical retention). The opacity of the effective retention is further muddied by the fact that for options involving some form of first loss retention (option EU(d), EU(e), DF(b), and DF(c)), the degree of loss sharing through retention depends on the distribution of losses in a particular transaction (5% retention with a particular option in one transaction implies a different loss sharing than 5% retention with the same option in another transaction).

Investors cannot simply map the chosen retention format into a real number representing the default risk retained, so how much risk is effectively retained is unclear. From an investor's point of view, the degree of incentive alignment vis-à-vis issuers remains opaque. To overcome the resultant informational imperfection, we need a numerical measure of risk retention, beyond the mere categorical measure disclosed today. We will propose a measure that allows us to tackle the opacity issue in the next section.

3 Deriving a standardized skin-in-the-game metric for the use of regulators and rating agencies

3.1 The Retention Metric

If risk retention is relevant for issuer behavior, and thus for the value of a transaction, then investors need to know how much risk, or what proportion of the overall risk, is actually retained by the issuer. Since default risk is the outcome of a stochastic process, a metric that captures risk retention has to rely on the entire loss rate distribution.

Thus, we propose a retention metric, $\mathcal{RM}$, capturing the *portion of overall portfolio losses that the originator retains.* Formally, the retention metric, $\mathcal{RM}$, is defined as follows:

$$\mathcal{RM} = \frac{E[retained\ portfolio\ loss]}{E[total\ portfolio\ loss]} = \frac{\int_0^1 r \cdot f_R(r)\,\mathrm{d}r}{\int_0^1 p \cdot f_P(p)\,\mathrm{d}p}, \tag{1}$$

where $f_R(r)$ is the density function of retained losses (r), and $f_P(p)$ is the density function of total portfolio losses (p). In deriving $\mathcal{RM}$, we assume expectations to be rationally formed, in the sense that investors correctly anticipate originator behavior, on average, including the effects that risk retention has on the decisions made by the issuer. Moreover, the rational expectations assumption can be used to characterize the assignment of rating notches to newly created securitization tranches, as is commonly done by rating agencies. In that case, agencies rely on their expertise and year-long experiences to anticipate the cash flow consequences of a particular retention level chosen (by the issuer). In equilibrium, or over long periods of time, the agency's expectation is assumed to be correct.

Note that $\mathcal{RM}$ is bound by zero and one. $\mathcal{RM}$ equals one if all possible losses are borne by the originator. Similarly, $\mathcal{RM}$ equals zero if no losses are retained. For partial retention,

$\mathcal{RM}$ takes a value between zero and one. By construction, retaining more junior tranches automatically leads to a higher value of $\mathcal{RM}$ as compared to retaining more senior tranches of equal size.

The $\mathcal{RM}$ metric has several useful properties. The metric is easily understood and it is normalized to the interval between zero (for no retention at all) and one (for full retention); that is, the metric rises with the extent to which default losses are retained. A metric closely related to ours captures the level of expected loss in the first loss tranche, the so-called "loss share" (see Franke et al. (2012)). The $\mathcal{RM}$ metric equals the loss share if, in case of option (d), the retention requirement is exactly met with the size of the first loss piece.

Another property of the $\mathcal{RM}$ metric is that it naturally gives first losses higher weight than second and higher level losses. Retaining a fraction of a senior tranche entails very little default risk, since the default probability of an AAA-rated tranche, and equally its loss given default, tends to be very small. Hence, the retention of a senior tranche, or parts thereof, will have very limited, if not zero positive incentive effects.

In practice, the natural question to ask when considering the proposed risk retention metric for valuation purposes is this: What ensures the quality of the data used to compute the metric? Do investors trust the metric if they have no access to the underlying original data and multiple incentive conflicts are in play? How can investors be sure that there is no bias in the metric, motivated perhaps by some side payments, or by paying the entire valuation process? The obvious incentive conflict needs to be overcome in a transparent way, in order to render the proposed metric a credible piece of information in financial markets.

We will discuss the issue of metric credibility at greater length in Section 4. Suffice it to say at this point that credibility can be achieved by tying the computation of the retention metric directly to the structuring process itself. The latter is typically carried out or approved by an established rating agency that, in the process, assigns rating labels to individual tranches of the issue at hand. To assign such ratings, agencies have to carry out a full-fledged loss rate simulation of the underlying asset portfolio over the entire range of the assets' nominal value. Once these data are available, the proposed retention metric can be easily retrieved, provided, of course, the share of the retained tranches is disclosed via the agency (more on the credibility issue can be found in Section 4).

3.2 Using the metric to compare the legal retention options

Next, we apply the new retention metric, $\mathcal{RM}$, to major admissible options under the existing regulatory regimes in the EU and the US. Note that the menu of options is partly the same in the EU and the US. Both allow for horizontal and vertical rules, and the US also allows for combinations of those two basic alternatives. Moreover, the EU regulation admits three additional options, namely, 5% of every single exposure, 5% of randomly selected exposures, and 5% of first losses in every individual exposure. Furthermore, the EU bases its rules on the nominal value (i.e., face value) of the exposures, while US rules refer to fair values (i.e., market values).

Both regimes will be discussed separately. The "fair value" of an exposure refers to the market price or, in the absence of liquid secondary markets, a credible estimate of a secondary market price. Under normal circumstances, this fair value captures expected loss. For example, if valuation is based on risk neutrality, the fair value of a tranche is the discounted value of [(1-EL)*EAD], where EL is expected loss in percentage points, and EAD is the exposure at default of a particular tranche. Expected loss is given as EL=p*LGD, where p is probability of default, and LGD is loss given default in percentage points. The fair value will be large and approach the nominal value if the expected loss is small and vice versa.

To present a simple numerical example, Table 3 shows the retention metric for the most prominent options. Assume that a transaction consists of only two tranches, namely, a 5% first loss piece and a 95% senior tranche. Further assume that the expected losses are 21% for the first loss piece and 1% for the senior tranche. Combining these numbers shows that the expected loss of the entire portfolio is 2%. In the case of the 5% vertical retention, that is, withholding an equal share of all tranches, the retention metric, $\mathcal{RM}$, equals 5% (since 5% of the expected losses are retained). In the case of the 5% horizontal retention (withholding the entire first loss tranche in the example), the retention metric equals 52.5% ($\mathcal{RM}$=5%x21%/2%=52.5%). The example shows that the actual level of retention can differ significantly across options in terms of the expected loss for the same obligatory retention level.

As the next step, we show which values the retention metric can take in general for all available retention options in the two jurisdictions, EU and US (Table 4). The upper part of the table has the five options in accordance with the EU regulation, and the lower part shows the three options offered to US issuers. The numbers in Table 4 show how the retention options differ between the EU and the US in terms of nominal retention, and the table shows how effective retention differs between the different options even within one regulatory framework. For simplicity, and without loss of generality, we rely on the expected values when referring to fair values and assume risk neutrality in the valuation.

The retention metric, $\mathcal{RM}$, takes the value of 5% for retention options EU(a)-(c) and for option DF(a). These options imply forms of vertical retention, that is, the retention of portions that are of equal risk as compared to the non-retained portion. In these cases, retaining 5% of the reference portfolio always implies retaining 5% of the losses. In the case of horizontal retention, that is, option EU(d) and DF(b), $\mathcal{RM}$ takes a higher value, ranging from 5% up to 100%. This implies that horizontal retention is always associated with a higher fraction of loss retention than is vertical retention, and it may be substantially higher. Option DF(c) implies effective retention values between those of the vertical options and the horizontal options. The retention metric, $\mathcal{RM}$, takes a value higher than 5%.

Finally, option EU(e) also implies a form first loss retention. Thus, the retention metric, $\mathcal{RM}$, takes a value higher than 5%, but the value is lower than the one achieved with pure horizontal retention since the loss participation of the retained portion is truncated at 5% at the level of each individual exposure in the portfolio. Under this scheme, a 5% first-loss stake in every single loan in the securitization transaction is retained, and the loss taken by the originator is min(LGD, 5%). For example, if LGD = 20%, then the originator takes 5% and investors 15%. If loss realized in case of default (LGD) is 3%, then the originator takes the full 3%. Thus, effective retention is always lower than in the case of horizontal retention (option EU(d)), and it is higher than vertical retention (option EU(a)). Expected loss then depends on the number of defaulting loans in a given portfolio and the loss realized in case of default, since the loss participation of the retained portion is truncated at 5% of each individual loan. If the LGD per loan is low, then rule EU(e) can produce a retention metric significantly larger than 5%.

The L-shape option under Dodd-Frank (combination of horizontal and vertical slice), that is, option DF(c), allows to target any desired level of the retention metric between the horizontal and vertical options with an appropriate choice of weights.

The concept underlying the EU option EU(c) also has been discussed under the DFA in the US. However, as the SEC "final rule" document shows, operational difficulties with the proper (i.e., incentive-compatible) implementation of this retention option have led the SEC to remove the option from the set of available retention options.

Overall, Table 4 provides a general comparison of the retention options for both regulatory regimes. The table shows numbers for the retention metric $\mathcal{RM}$ or ranges for $\mathcal{RM}$, where appropriate. The exact numbers depend on the loss distribution of the reference portfolio and thus typically differ from transaction to transaction. To push our point further, namely, that disclosing the type of retention option and size of the retained piece is not sufficient to know what share of expected loss is actually retained, we need to compute the loss rate distribution of a concrete transaction. We will do this next.

3.3 Applying the retention metric to a real-world example

In the previous section, we argued that different retention options in the US and the EU imply different levels of retention in terms of expected loss. In this section, we closely look at the shape of the loss rate distribution and its role in allocating expected loss to individual tranches. The analysis will allow us to compare actual (expected) loss allocation to legally admissible retention options, while holding the loss rate distribution constant. London Wall 2002, a real-life ABS transaction issued by Deutsche Bank in 2002, will serve as the model example for our comparative analysis.

The methodology we are using to estimate the loss distribution of a portfolio was previously developed and has been used by major rating agencies, based on the academic work of Schönbucher (2000) and Vasicek (1987). The methodology also has been used by investment banks in their advisory work on asset securitization. We will use the portfolio loss distribution from our model example to determine the value of the retention metric under different retention options.

Moody's new issue report (Moody's (2002)) gives transaction information. Figure 1 shows the structure of the London Wall 2002-2 transaction. The securitized reference portfolio has a value of 1.8 billion euros. It is split into 12 tranches of different seniority, except for tranches A1 and A2, plus tranches B1 and B2, which have the same seniority, but different currencies. Of these 12 tranches, 11 tranches are rated, corresponding to 97.39% of the nominal value of the transaction. The biggest part of the nominal value (84.49%) is covered by the most senior tranche (in the London Wall case represented by a Senior Credit Default Swap). The non-rated, most-junior tranche, that is, the first loss piece, amounts to a comparably tiny 2.61% of the nominal value.

We refer to the offering circular for the composition of the reference portfolio. We estimate the loss distribution of the portfolio by inputting the provided information into a Monte Carlo simulation, following the approach described in Krahnen and Wilde (2006). The information taken from the issues offering circular includes information on the reference portfolio (e.g., the number of loans, the number of different obligors, maturities, exposure sizes, loan ratings, industry composition, diversity score). Data on rating migrations and recovery rates are taken from Moody's tables. Based on this input data, we generate default scenarios for all individual obligors. Aggregating these simulation results leads to a loss distribution of the entire portfolio. Figure 2 shows the resultant loss distribution of the London Wall reference portfolio. The figure assumes the standard simulation parameters utilized by Moody's rating calculations. The simulations rely on the standard assumptions used by Moody's for this transaction, namely, a uniform bivariate correlation among exposures of 0.3 for issuers within the same industry, a Baa2 average rating (with some dispersion), and a total of 264 loans in the portfolio. To simplify the simulation exercise, we assume all securitization notes to be of a bullet nature, where all accumulated interest payments are paid out in one final payment.

The London Wall transaction shows a compressed loss distribution around a relatively low mean value of 1.49%. Note that the horizontal axis is truncated at 10%, implying that the loss distribution is concentrated at the very left end of the entire range. Thus, small losses occur and are quite likely, while large losses essentially do not occur. This structure leads to a rather small first loss piece, wherein most of the probability mass is concentrated, and a rather large senior tranche.

A vertical slice implies a portion of the portfolio with equal risk. Thus, the loss distribution of a vertical slice is exactly the same as the loss distribution of the entire portfolio. A horizontal slice, however, implies a different risk profile. Figure 2 shows how the portfolio risk is redistributed in the case of horizontal slicing. A retention requirement of 5% in nominal terms, as implied by EU regulation, leads to slicing as the figure depicts. The retained first loss piece amounts to 5% of the portfolio's face value, while the securitized portion amounts to the remaining 95%.

The first loss piece contains the major part of the risk, while the senior portion is protected by the junior first loss piece. Thus, the loss distributions of the two slices are entirely different. While the first loss piece is almost always hit by some losses, the senior tranche is rarely hit. Correspondingly, the first loss piece has a higher default probability, mean loss, loss standard deviation, and loss given default compared to the senior tranche. Thus, the transfer of risks is non-proportional because of the principle of subordination implied by horizontal slicing.

Table 5 presents comparative results of the retention metric for eight retention options, five from the EU regulator [EU(a)-(e)], and three from the US regulator [DF(a)-(c)]. We use the letters "EU" and "DF" together with the letters (a)-(e) to designate the different options under the EU and US rules, respectively. The European rules EU(a) to EU(e) are listed in CRD IV, Article 405. Options EU(b), EU(c), and EU(e) reference individual securitization exposures (e.g., loans), whereas options EU(a) and EU(d) reference the entire reference portfolio. The US rules DF(a) and DF(b) comprise the vertical and the horizontal rules; a linear combination of both is DF(c), the so-called "L shape".

The estimation results reported in Table 5 are based on the input parameters defined by the London Wall case, described above. The reliance on the specific example of London Wall is without loss of generality, and qualitatively similar results are achieved when the parameters of the model are altered, that is, the assumptions concerning the expected loss of individual exposures, their pairwise correlations, and the exposure-specific loss given default estimates are increased or decreased (reported in Panels B and C). Specifically, the bilateral correlation assumption is increased to 0.4 in panel B, the default risk is changed by assuming that each loan is rated one notch lower (Panel C).

The retention metric, calculated for each retention option, is shown in the last column of Table 5. One can see that the retention options EU(a), EU(b), and EU(c) have identical retention metrics in all three panels, suggesting an invariance to change in the modeling assumptions. The retention options EU(a), EU(b), and EU(c) are equivalent; they all imply the same degree of skin-in-the-game of 5%. Moreover, that level is already determined by the retention volume (i.e., 5%), and it is the same regardless of the composition of the portfolio and portfolio quality.

This is not surprising, as it is well known that the expected value of a sum of random variables is the sum of their expected values. Hence, retaining 5% of each individual exposure results in an expected loss retention of 5% and, similarly, retaining 5% of each tranche leads to the same expected loss retention statistic.

Now let us turn to Option EU(d), which can lead to a very high level of effective risk retention, as can be seen in Table 5. The retention metric, $\mathcal{RM}$, takes a value much larger than 5%. In the base case, $\mathcal{RM}$ is equal to 99.86%, which is 20 times as much as in options EU(a) to EU(c). A comparison of Panels A, B, and C shows that for option EU(d), the $\mathcal{RM}$-statistic is more sensitive to the properties of the underlying asset portfolio than any other available option. The London Wall transaction has a rather homogeneous portfolio of loan assets of high average quality, which leads to a loss distribution with low mean loss, low variance, and high skewness, yielding a high retention metric under the horizontal 5% rule. The metric is sensitive to changes in asset correlations and default probabilities (Panels B and C of Table 5).

If applied to the London Wall case, EU(e) in Table 5 yields a value of 8.81% for the retention metric. The mean loss of the retained piece is 2.6%. Note that in the case of the London Wall transaction, the largest loss realization observed in our simulation is just above 6%, which is very close to the 5% covered by the retention rule. The value of the retention metric is inversely proportional to the loss per loan, conditional on default, that is, it is high for low LGDs and vice versa, reaching 100% for LGD values of 5% or less.

Turning to the rules under Dodd-Frank Act, we look at lines 6 to 8 of Panel A in Table 5. Again, the same underlying securitized loan portfolio is assumed, that is, London Wall 2002. The main difference between the European and the American approaches to risk retention relates to the way nominal retention size is measured. While the European regulation relies on the face value of outstanding claims, the Dodd-Frank Act is based on fair value measurement. For the purpose of the present study, we approximate the fair value of a financial instrument using the instrument's expected value under risk neutrality, where repayment expectations reflect default risk and loss given default from the Moody's tables that were used to structure the transaction at the time of issuance.

The question is whether the use of fair values affects the retention metric. A comparison of DF(a) with EU(a) in Table 5 shows the equivalence of the vertical slice under both regulatory regimes. However, a comparison of EU(d) with DF(b), that is, the horizontal slice, reveals that effective retention is larger under US rule, since the size of the retained piece in terms of nominal values is larger under Dodd-Frank. This is because under fair value consideration, a larger portion of the low-value first loss parts needs to be retained to achieve 5% retention.

As far as robustness is concerned, we can look at Panels B and C in Table 5. Changing the parameters of the basic simulation model does not change the resultant retention metrics by much. All qualitative results remain unchanged.

4 Implications for policy makers, regulators, and rating agencies

In this paper, we suggest a simple measure to capture the effective risk retention in ABS transactions. The metric, $\mathcal{RM}$, expresses in a single number the share of risk in terms of the expected loss of the securitized assets the originator is retaining in its own portfolio. The value of $\mathcal{RM}$ lies between zero and one. According to standard agency models, the higher the value of $\mathcal{RM}$, the closer is the alignment of incentives between asset originators and tranche investors.

When applying the metric to the set of admissible options under the existing EU regulatory regime, we find the available options to vary with respect to effective retention: First, for the same securitization transaction, effective retention may be small under one option and large under another one. Second, for the same option, and assuming the fulfillment of the legal minimum requirement, effective retention varies with the shape of the loss distribution. Together, both observations imply a certain level of opacity in the securitization market, as far as the effective level of retention or actual risk bearing is concerned.

We verify the relevance of opacity in today's markets by analyzing European securitizations, covering the years since inception of the retention standards. There, we find that three (of a total of five) available retention options are frequently used in existing transactions, while the remaining two options are not used at all. Furthermore, we find that for the horizontal retention formats in our European sample, actual retention levels often substantially exceed the 5% minimum. Combined with the fact that the horizontal format is the most frequently chosen option, the opacity problem becomes even more relevant.

This leads to the main insight of our analysis for policy making, namely, the necessity of resolving the high degree of opacity of risk retention. The standard way to tackle opacity, which is also our proposed solution, is to increase transparency. In this case, we recommend reporting a standardized metric capturing effective risk retention, like $\mathcal{RM}$, along with the retention option chosen and the size of retention.

If this information set is known, including the retention metric, retention option chosen, and size of retention, then the market is fully transparent, and investors can "look through" a transaction, and anticipate potential incentive conflicts. The above information set facilitates market discipline and helps find market prices that properly reflect potential incentive conflicts.

Moreover, if $\mathcal{RM}$ is reported, together with retention option and size, why regulate a specific minimum retention level of, say, 5%? On the contrary, a standard retention requirement may not be optimal as it only accidentally exactly matches the optimal retention amount in a given transaction. Rather, assuming full transparency about $\mathcal{RM}$, issuers and investors can freely select the effective level of retention they find best suited to minimize agency costs, that is, the extra funding costs caused by the incentive misalignment between issuers/originators and investors.

In fact, in strengthening the case for transparency, the reported US evidence suggests the 5% requirement to be a binding constraint. The evidence suggests a demand for flexibility in retention levels by issuers, thus questioning the prescription of a flat 5% rule for all available options.

A retention regulation based on disclosing $\mathcal{RM}$ would, therefore, enhance the contractual design's flexibility. However, to be truly useful for market valuation, the metric, $\mathcal{RM}$, must be trusted by investors. Therefore, the question of how to ensure credible $\mathcal{RM}$ reporting is a major issue that needs to be resolved before policy makers can embark on the proposed reform of the minimum retention requirement. Recognized bond rating agencies, like Moody's and Standard & Poor's, are potentially well equipped to play the role of a trusted information provider.

In fact, rating agencies are already involved in the structuring decision of issuers when tailoring tranche sizes and by assigning ratings to individual tranches (see Cantor et al. (2002)). Similar to these models, $\mathcal{RM}$ is based on the stochastic properties of cash flows generated by the underlying asset pool. The necessary calculations are identical to those carried out by agencies when rating an individual tranche of the same transaction. Thus, $\mathcal{RM}$ is already available, in principle, through the work of rating agencies.

The two types of disclosure, the rating of a tranche and the share of retained default risk, to a large extent rely on the same information. Thus, if an agency assigns tranche ratings deemed credible in the market, then the retention metric $\mathcal{RM}$ also can be assumed to be credible. The only additional data needed to compute $\mathcal{RM}$ relates to the information about which tranche is retained and which one is not.

Thus, if the market trusts in issuer-paid agency ratings, it should trust equally in issuer-paid $\mathcal{RM}$ statistics. A theoretical reasoning to explain why agency ratings are trusted by investors builds on the reputational model of information disclosure (see Kreps and Wilson (1982) and Bolton et al. (2012)).

In conclusion, today's regulation of retention disclosure does not go far enough. It stops short of requiring issuers to disclose effective retention. Our proposed $\mathcal{RM}$ metric is a feasible solution to this problem. We recommend replacing today's flat 5% minimum requirement by a disclosure obligation for effective issuer retention. This way, market discipline in securitization markets can be expected to rise. We rely on a reputational argument to support the trustworthiness of agency-backed $\mathcal{RM}$ disclosure for all securitization transactions.

Once implemented, the proposed retention metric would allow issuers to use retention as a signal to investors, a signal that could potentially enhance market discipline via the initial pricing of tranches. That way, disclosure of a standardized retention metric could help to improve transparency, facilitate pricing, and strengthen the development potential of ABS markets more generally.

Tables

Table 1: Retention options chosen in EU and US transactions

This table presents empirical results on the retention options chosen in real transactions in the EU and the US under the new legislation (i.e. CRD IV and DFA). Data for the EU is extracted from official filings submitted to ESMA, and data for the US is taken from Flynn et al. (2020), Section 1.2. The columns present, from left to right, name of regulation, description of regulation, number of transactions in the EU, and number of transactions in the US.

Retention options chosen in EU- and US-transactions					
Regulation	Description	EU transactions		US transactions	
		number	percent	number	percent
EU(a)	5% of each tranche (vertical slice)	21	18%		
EU(b)	5% of each individual exposure	0	0%		
EU(c)	5% of randomly selected exposures	24	20.5%		
EU(d)	5% horizontal slice (first losses)	72	61.5%		
EU(e)	5% FLP of each exposure	0	0%		
DF(a)	5% of each tranche (vertical slice)			129	43.4%
DF(b)	5% horizontal slice (first losses)			139	46.8%
DF(c)	5% L-shaped slice			29	9.8%
Total		117	100%	297	100%

Table 2: Retention amount (retained portion) in EU and US transactions

This table presents summary statistics on the retained portion in EU transactions under the new legislation (i.e. CRD IV) and in US transactions, broken down by the chosen retention option. The numbers for the EU are based on nominal values, and the numbers for the US are based on fair values, in line with the regulatory requirement in the respective jurisdiction. The data for the EU is extracted from offering circulars of transactions for which filings were submitted to ESMA during the time period from March 22, 2019 to January 27, 2021. The results for the US are calculated from the overview of transactions provided in Table 3 in Flynn et al. (2020). The columns indicate statistics on the retained portion (number of deals, mean, median, and standard deviation), and the rows indicate the chosen retention option.

Panel A: Retained portion in EU-transactions (based on nominal values)				
Retention option	N	mean	median	std
EU(a) (vertical slice)	8	0.050	0.050	0.000
EU(b) (share of each individual exposure)	0	-	-	-
EU(c) (randomly selected exposures)	11	0.062	0.054	0.015
EU(d) (horizontal slice)	53	0.104	0.080	0.070
EU(e) (FLP of each individual exposure)	0	-	-	-
Total EU	72	0.091	0.070	0.063
Panel B: Retained portion in US-transactions (based on fair values)				
Retention option	N	mean	median	std
DF(a) (vertical slice)	154	0.0500	0.0500	0.0000
DF(b) (horizontal slice)	49	0.0503	0.0502	0.0004
DF(c) (L-shaped slice)	23	0.0505	0.0504	0.0003
Total US	226	0.0501	0.0500	0.0003

Table 3: Retention metric - example

This table presents a simple example on how the retention metric is calculated for the different retention options, including vertical and horizontal slice retention. The upper part of the table presents as an example a transaction with two tranches with certain expected losses. The bottom part of the table presents the retention metric for this example transaction according to different retention options.

Simple example: expected losses for different tranches	
Tranches	Expected losses
5% first loss tranche	21%
95% senior tranche	1%
Total portfolio	2%
Retention metric for different retention options	
Retention option	Retention metric $\mathcal{RM}$
5% vertical slice (share of each tranche)	5%
5% horizontal slice (first losses)	52.5%

Table 4: Retention metric (general)

This table presents, for a general case, the retention metric as applied to the different retention options according to CRD IV and DFA. The columns present, from left to right, name of regulation, description of regulation, calculation basis, size of retention, and retention metric.

		Retention options			
Regulation	Description	calculation basis	size of retention (regulation)	size of retention (nominal)	Retention metric $\mathcal{RM}$
EU a)	5% of each tranche	nominal value	5%	5%	5%
EU b)	5% of each individual exposure	nominal value	5%	5%	5%
EU c)	5% of randomly selected exposures	nominal value	5%	5%	5%
EU d)	5% horizontal slice (first loss)	nominal value	5%	5%	5%-100%
EU e)	5% FLP of each exposure	nominal value	5%	5%	>5%
DF a)	5% vertical slice	fair value	5%	5%	5%
DF b)	5% horizontal slice	fair value	5%	>5%	5%-100%
DF c)	5% L-shaped slice (50%-50%)	fair value	5%	>5%	>5%

Table 5: Retention metric (London Wall)

This table presents, for the London Wall 2002-2 transaction, the retention metric for the different EU/US retention options. The columns present, from left to right, name of regulation, description of retention option, calculation basis, size of retention in terms of the regulatory standard (nominal/fair value), size of retention in terms of the nominal value, mean loss of retained portion, and retention metric. In Panel A (London Wall), the reference portfolio consists of 264 loans from 22 distinct obligors, a minimum diversity score of 70, a minimum average rating of Baa2, and a minimum average recovery rate of 45%. Following the practice performed by rating agencies, the correlation for loans within an industry is assumed to be 0.3, while between-industry correlation is assumed to be zero. The loss distribution is calculated with 10,000 simulations. In Panel B, the base case is altered and the default correlation is increased to 0.4 (within industry). In Panel C, each loan is assumed to be rated one notch lower.

Regulation	Description	calculation basis	size of retention (regulation)	size of retention (nominal)	mean loss	Retention metric
Panel A: London Wall transaction						
EU a)	5% of each tranche	nominal value	5%	5%	1.5%	5.00%
EU b)	5% of each individual exposure	nominal value	5%	5%	1.5%	5.00%
EU c)	5% of randomly selected exposures	nominal value	5%	5%	1.5%	5.00%
EU d)	5% horizontal slice (first loss)	nominal value	5%	5%	29.8%	100.00%
EU e)	5% FLP of each exposure	nominal value	5%	5%	2.6%	8.81%
DF a)	5% vertical slice	fair value	5%	5%	1.5%	5.00%
DF b)	5% horizontal slice	fair value	5%	6.4%	23.3%	100.00%
DF c)	5% L-shaped slice (50%-50%)	fair value	5%	5.7%	12.4%	47.35%
Panel B: Different correlation ($\rho = 0.4$)						
Regulation	Description	calculation basis	size of retention (regulation)	size of retention (nominal)	mean loss	Retention metric
EU a)	5% of each tranche	nominal value	5%	5%	1.5%	5.00%
EU b)	5% of each individual exposure	nominal value	5%	5%	1.5%	5.00%
EU c)	5% of randomly selected exposures	nominal value	5%	5%	1.5%	5.00%
EU d)	5% horizontal slice (first loss)	nominal value	5%	5%	30.2%	100.00%
EU e)	5% FLP of each exposure	nominal value	5%	5%	2.6%	8.73%
DF a)	5% vertical slice	fair value	5%	5%	1.5%	5.00%
DF b)	5% horizontal slice	fair value	5%	6.4%	23.5%	100.00%
DF c)	5% L-shaped slice (50%-50%)	fair value	5%	5.7%	12.5%	47.31%
Panel C: Different default probability (rating one notch lower)						
Regulation	Description	calculation basis	size of retention (regulation)	size of retention (nominal)	mean loss	Retention metric
EU a)	5% of each tranche	nominal value	5%	5%	2.3%	5.00%
EU b)	5% of each individual exposure	nominal value	5%	5%	2.3%	5.00%
EU c)	5% of randomly selected exposures	nominal value	5%	5%	2.3%	5.00%
EU d)	5% horizontal slice (first loss)	nominal value	5%	5%	38.9%	84.81%
EU e)	5% FLP of each exposure	nominal value	5%	5%	2.9%	6.34%
DF a)	5% vertical slice	fair value	5%	5%	2.3%	5.00%
DF b)	5% horizontal slice	fair value	5%	7.2%	30.7%	95.84%
DF c)	5% L-shaped slice (50%-50%)	fair value	5%	6.1%	16.5%	43.70%

Figures

Figure 1: Overview of the London Wall 2002-2 transaction

This diagram presents the structure of Deutsche Bank's London Wall 2002-2 transaction, based on Moody's New Issue Report.

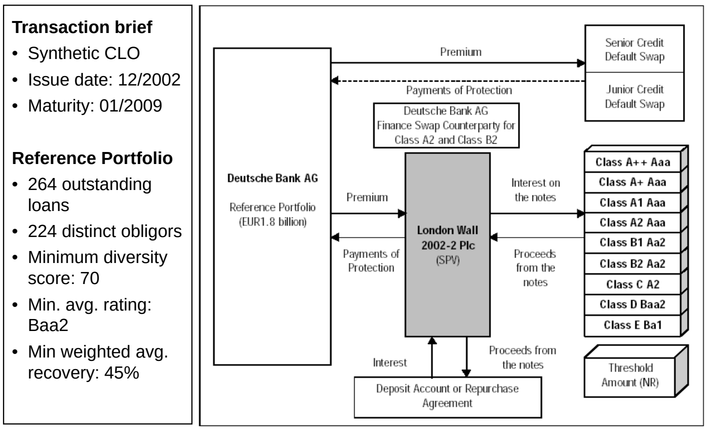


Figure 2: Real-world tranching example: The London Wall 2002-2 transaction

This diagram presents the simulated loss distribution of Deutsche Bank's London Wall 2002-2 transaction. Relevant information on the reference portfolio as provided in the offering circular is used as basis for the simulations. The assumed correlation structure is 0.3 within industries, and 0 between industries. Credit migration risk is modeled according to Standard and Poor's rating migration table. The horizontal axis denotes the portfolio loss rate (PLR), and the vertical axis denotes the associated probabilities based on 50'000 simulation runs. The red line shows the boundary of a 5% horizontal slice (first loss piece).

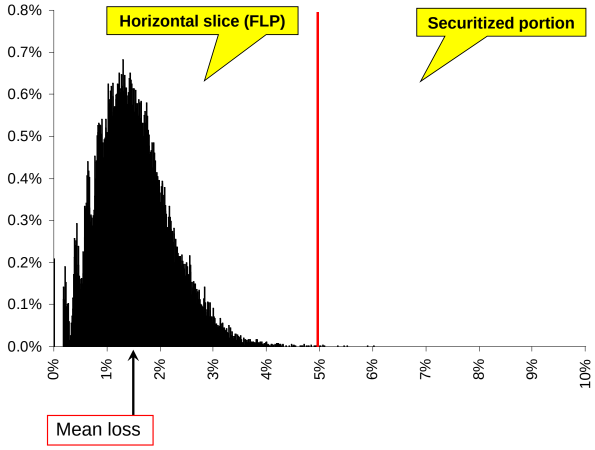
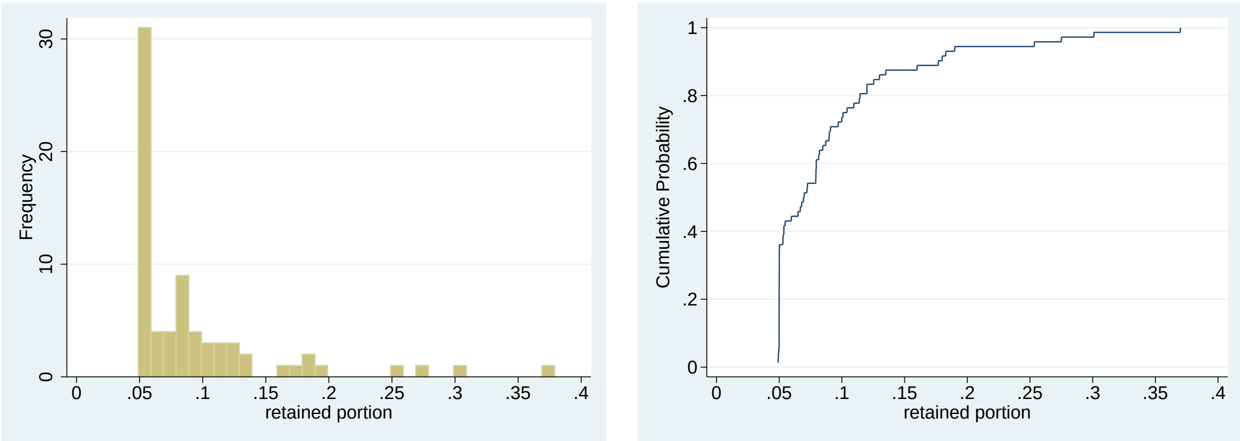


Figure 3: Statistics on the retained portion

This figure presents statistics on the retained portion in EU STS transactions. The diagram on the left side shows the histogram of the retained portion, the diagram on the right side shows the cumulative distribution of the retained portion.

(a) histogram (b) cumulative distribution



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