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

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Abstract

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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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April 5, 2021

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We compare mandatory risk retention, a cornerstone element of post-financial crisis regulation, in the US (Dodd Frank Act) and the EU (Capital Requirement Regulation). While minimum retention is uniformly five percent, realized risk retention varies significantly across jurisdictions and available options. We analyze empirically for a sample of securitization transactions the choice among retention options and the retained portion. We find that in the EU, the legally imposed retention minimum is not binding for the majority of the transactions, in contrast to the US. To facilitate the disclosure of retained interest, we propose a comprehensive metric capturing effective risk retention, permitting a clean comparison across retention options.

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1 Introduction

The collapse of securitization markets, particularly in the case of securitizations based on housing loans, mark the onset of the financial crisis in 2007. Reports suggesting unexpectedly low credit quality led prices of securitization tranches to tumble and market liquidity to disappear. Fraudulent marketing behavior of US real estate lenders, typically relying on an unqualified and adversely motivated sales force, was widely blamed for losses in real estate lending. Academic research has found evidence for the presence of big scale mis-selling in mortgage markets, see for example Keys et al. (2010).

With respect to securitizations, an important insight from the subprime mortgage lending crisis is this: the standard design of a credit ABS (asset backed security) violated fundamental incentive conditions, as spelled out in the theoretical literature (Cerasi and Rochet (2014)). Without a deductible of sufficient magnitude, originators of credit securitizations bundling loans and repackaging them in a set of bond-like instruments, were neither motivated enough to engage in proper screening of loan applicants, nor were they interested in strict monitoring over the life of the loan contract. As a remedy of the incentive problem, loan originators should keep the default risk, or parts thereof, on their own balance sheet, i.e. they should hold on to a sufficiently large *skin in the game*. This will help to align the incentives of the originator with those of the investor (Franke and Krahnen (b) 2009).

On the policy side, the G20 Pittsburgh summit in 2008 concluded with a plea for credit risk retention in order to induce a strong alignment of interest of investors and originators/issuers. Similar arguments were raised by the international association of supervisors, IOSCO. Following this, strong acceptance of the retention idea can be observed, with an extensive regulatory push for minimum skin-in-the-game requirements, both in the US and the EU.

In the US, the current efforts to nail down a skin-inthe-game property through specific retention options are found in the Dodd Frank Act (DFA (2010)), with implementation rules specified by the SEC, see SEC (2014). In the EU, similar efforts have led to CRD IV and CRR (EC (2013)), with implementation proposed by the European Banking Authority (see EBA (2016)). In both the US and the EU, the current rules approve several options for fulfilment of the risk retention condition. These options comprise a vertical slice of all tranches and a horizontal first loss slice as the two basic options in both jurisdictions. The US allows a combination of these basic options, whereas in Europe there are other options as well, including a random selection of securitized assets, which would allow to sell all securitization notes to investors.

Several questions arise: Should the retention in securitizations be obligatory? And if so, is the choice set of options offered by the legislator adequate, allowing retained risk to vary with characteristics of the underlying asset portfolio, like asset class or moral hazard?

In this paper, we ask whether the mandatory incentive compatibility requirement has become effective in securitization markets. For this purpose, we take a look at the implementation of these rules in the US and in the EU, and assess empirically whether the five percent rule is binding in Europe, as it has recently been shown for the USA, Flynn et al. (2020) and Furfine (2020). We find evidence in a European sample of qualified securitization transactions (STS transactions) that the retention rule is not binding.

We conclude that effective retention is valuable information for investors, and propose a new metric that summarizes effective risk retention in a given transaction. This retention metric $\mathcal{RM}$ is defined as the portion of expected losses of a given transaction that is withheld by the originator. The metric naturally ranges between zero for no retained losses, and one for full loss retention.

It is common practice in the literature to characterize retention levels via the chosen retention type, rather than by some quantitative measure. Typically, whether retention is horizontal, vertical, or hybrid is the main information investors receive. We build on this and measure the retention level of a securitization transaction by estimating the retained loss share. Our methodology may therefore be used for empirical analyses and for pricing of tranches across retention types.

In terms of policy implications, we find regulatory efforts concerning securitization markets to go in the right direction, by forcing issuers to disclose their own interest in a transaction. However, different retention options typically imply different levels of effective risk taking, in terms of expected loss. Surprisingly, the actual level of retention is not fully disclosed to investor. We propose a simple metric that captures effective retention $\mathcal{RM}$, and whose disclosure would greatly help improving transparency in market. Ultimately, an information triple consisting of option type and Euro size, combined with the implied effective loss retention, may replace today's minimum requirement.

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. In an empirical analysis based on a sample of qualified (STS) securitizations, we compare the choice of retention options and the retained portion between the EU and the US.

In Section 3, an easy-to-understand metric, which we label the retention metric $\mathcal{RM}$ is suggested. It is used to compare different retention rules for ABS. We show that actual risk retention varies significantly across the alternative rule specifications. Section 4 discusses policy implications of an improved retention metric, in particular for regulators and rating agencies.

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

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

2.1 Literature review

The market for asset backed securities has increased sharply since the mid 1990s, along with an interest in the theory of structured finance, and the empirical evidence. 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 (a) 2006, and 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 value of loans. Loan sales, as a consequence, have to deal with a potential loss in value that follows from a separation of the origination of loan from its holding as an investor (Gorton and Pennacchi (1995)). Bundling of several loans in a portfolio and subsequent tranching of portfolio proceeds into securities that are subordinate to one another, ranging from an equity piece to a senior tranche, is one way to reap the benefits of diversification and liquidity when there is adverse selection risk. 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 to create information-insensitive securities, i.e. senior bonds, that are liquid and which 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 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 what to retain dominates a situation without government intervention.

Since, in principle, retention can be achieved in different ways, e.g. by taking a share of each tranche (vertical retention), or by taking a chunk of a single tranche (horizontal retention), the question arises whether all forms of retention are alike, if only 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, i.e. first loss retention, dominates a 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, owed to the lack of disclosure, and has instead looked at the size of the first loss piece. basically assuming retention. Haensel et al. (2006), equating 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, effective risk transfer from banks (as originators of the pooled loan assets) to capital markets (e.g. institutional investors) is determined by the allocation of the junior-most tranche, the so-called equity piece. Significant risk transfer, therefore, would require selling at least part of the first-loss piece to outside investors.

There has been a lot of empirical work on the performance of asset backed securities since the outbreak of the financial crisis in 2007; a detailed description of the ABS market is in Ashcraft and Schuermann (2007). Keys et al. (2010) find evidence for a negative impact of securitization (likelihood) on ex-ante screening effort 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 in 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) find similarly 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 was associated with more or less corporate risky lending. They compare two data sets with largely similar loan portfolios, one of which was transformed into a collateralized loan obligation (CLO) while the other was 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 believes in the literature, as the result of the a strong reputation mechanism inherent in the syndication process.

Kara et al. (2015), in a difference-in-difference 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 for the incentive effect of loss retention.

The empirical literature discussed so far has not relied on actual retention data, but rather avoided any statement on the allocation of actual tranche holdings. Only recently, data about actual retention decisions of issuers have 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-difference estimation, showing 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 them 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 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 both find the minimum retention requirements to be binding. This result suggests 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 which belong to the class of STS (simple, transparent, standardized) loan securitizations, established in 2019 and regulated as a separate asset class (EU regulation 2017/2402).

Overall, the literature shows the importance of incentive issues in securitizations. Regulators around the world have responded by defining retention requirements accordingly, demanding a minimum level of originator's skin in the game. Before exploring the Eurioean evidence in greater detail, we will evaluate in section 2.2. existing regulatory rules in the US and the European Union focusing on risk retention.

2.2 Skin-in-the-game in post-crisis regulation: the case of the EU (CRR, Art. 405) and the 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 around the world have tried to counter the observed loss of asset qualities in securitization processes through appropriate regulation. Accordingly, the official closing document of the September 2009 G20 Summit in Pittsburgh, the G20 Leaders Statement, included a pledge concerning the regulation of skin-in-the-game in ABS markets (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 define a large set of basic rules for an enhanced banking and financial market regulations, which 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 own interest of 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 explains on page 8, clause 57: "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."

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 is on "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 how to fulfill the 5% retention requirement. The "Final Rule" defines a menu of three options, including the two basic forms, vertical and horizontal retention rule. The implementation rule just cited defines a list of exemptions, largely related to the treatment of securities that enjoy government backing, e.g. from GSEs (Government Sponsored Entities), see pp. 533 seq. The three eligible options are:

(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 has been 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: *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 to the Dodd Frank Act, and similarly in the SEC final rule, there is no clear rationale 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, it is helpful to think of different intentions behind asset securitization. For example, a deposit taking bank which is subject to capital regulation may use loan securitization to get capital relief from its regulator, thereby gaining the opportunity to expand its loan business beyond what it could achieve without securitization. It will prefer a vertical slice because this allows to sell the 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 securitization of its accounts receivable ("leasing claims") to fund its asset pool. It will prefer to hold a horizontal tranche because this will maximize the size of the 'cheap' senior tranche providing the funding.

While there are three base options in the US regulation, there are five options in the EU regulation. The most basic options, 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, fulfilling the regulatory requirement. Horizontal retention, in contrast, refers to withholding the junior-most tranche, and if needed the most junior mezzanine tranche, followed by the second most junior mezzanine tranche, etc., until the retained issue volume reaches the 5% threshold. There are similarities and differences between these two regulations. As to similarities, both regulations stipulate the same numerical minimum retention level of 5 percent, and both prohibit the transfer of retained interest to third parties, or the hedging of that particular risk exposure.

As to differences, there are several that deserve mention. First, the US rule is based on 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, any fixed minimum retention requirement, say 5 percent, entails higher risk withholding under fair value accounting in contrast to nominal value accounting.

Second, DFA allows for a linear combination of vertical and horizontal interest, as long as it fulfills the 5% requirement. There is no such combination option under European law which maintains that 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, i.e. 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 also included in the US legislation, but eventually it was dismissed by the SEC 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 the EU regulation refer to tranching (the US regulation also applies to single tranche securitizations, while the EU regulation does not), marketability (US regulations only applies to securities, while EU regulation also applies to warehousing schemes), synthetization (the EU regulation also allows to comply with retention of synthetic instruments, while this is not possible under DFA), and squared transactions, re-securitizations (such transactions are prohibited under EU law).

Finally, and perhaps most importantly, in both cases, DFA and CRR, there are exemptions from the retention rule, the list of which is long and detailed in the case of the US (see SEC Final Rule on Credit Risk Retention, pp 282-562) https://www.sec.gov/rules/final/2014/34-73407.pdf). Under the SEC Final Rule, 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 defining simple, transparent, and standardized 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 daughter company of KfW 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 https://www.esma.europa.eu/policy-activities/securitisation.

As far as disclosure is concerned, the verifier agencies just mentioned produce a template containing relevant details on securitization transactions, based on the offering circular and further discussions with the issuing institutions. These templates for all transactions falling under the STS regulation are collected by ESMA and offered to the public via the European Statistical Data Warehouse. For example, concerning the random selection option (c) there exist detailed prescriptions to ensure random selection of assets into the securitization portfolio. Moreover, the identity of securitized loans is a back-office information not disclosed vis-à-vis front-office loan officers. Both features should mitigate moral hazard in option (c). However, there is no screening or examination of reported information, and there is no enforcement mandate. Thus, compliance is difficult to audit and is, ultimately, based on trust and reputation of the issuing institution.

The take-away from this section can be summarized as follows: 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. It is therefore argued by some commentators (see Sweet et al. (2019)) that compliance with both regimes simultaneously may be difficult to achieve, suggesting a relevance of 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 but also in fair value terms.

2.3 Empirical results on retention in the EU and the US under the new legislation

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 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, a total of 446 STS securitizations have been recorded by ESMA during the period ranging from March 22, 2019 to January 27, 2021. Among them, there are 185 public transactions and 261 private transactions. For the private transactions, there is no retention information available. The public transactions are all non-ABCP transactions, and they are originating from different EU countries. Among the 185 public transactions, 65 transactions are UK-originated transactions, for which official retention information is not available through ESMA, since they are no longer covered by ESMA 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 and mandatory filings for STS securitizations made available through ESMA, and we manually extract information on the retention amount from the offering circulars. Among 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 where 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 on 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 and 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.

A further breakdown of the sample on EU transactions according to type of underlying assets and originating country is shown in Table 2. In Panel A1, it can be seen that the three main types of underlying assets are auto loans/leases (47 transactions), residential loans/mortgages (40), and consumer loans (22). Panel A2 shows that, among auto loan/lease-transactions, retention option EU(c) (randomly selected exposures) is over-represented; among residential mortgage-transactions, retention option EU(d) (horizontal slice) is over-represented; and among consumer loan transactions, retention option EU(a) (vertical slice) is over-represented.

In Panel B1 of Table 2, it can be seen that the biggest originating EU-countries of STS transactions are Germany (30 transactions), the Netherlands (26), Italy (22), France (21), and Spain (12). Panel B2 shows that interestingly, in transactions originated in Germany and Spain, retention option EU(c) (randomly selected exposures) is over-represented; in transactions originated in France and the Netherlands, retention option EU(d) (horizontal slice) is over-represented; and in transactions originated in Italy, retention option EU(a) (vertical slice) is over-represented.

To formally determine to which extent the choice of a particular retention option is driven by the originating country and/or the type of underlying assets, we run logit regressions. The results in Table 3 show that there are both, significant originating-country and type-of-underlying-assets effects on the chosen retention option. In general, the type-of-underlying-assets effects seem to be stronger, since they always persist when including originating-country dummies in the regression.

In conclusion, transactions with consumer loans as underlying assets are significantly associated with option EU(a) (vertical slice retention), transactions with auto loans are associated with option EU(c) (retention of randomly selected exposures), and transactions with residential loans are associated with option EU(d) (horizontal slice retention).

The results on the retention amount (retained portion) in the EU are presented in Table 4 and Figure 3. For the 72 transactions in the sample, the mean retained portion is 9.1%, and the median is 7%. Both values are well above the retention level of 5% required by regulation. The size distribution of observed values in all transactions in Figure 3 shows that only in 31 out of 72 transactions, the retained portion is 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 findings for the US as documented by Flynn et al. (2020) and Furfine (2020).

The breakdown of the retained portion by type of underlying assets (Panel A in Table 4) reveals that both the mean and the median retained portion are above 5% for most types of underlying assets. Among the three biggest groups according to the number of observations, retention is greatest for consumer loans (with 11.3% mean value), followed by auto loans/leases (with 8.7% mean value), and residential loans/mortgages (with 7% mean value). A breakdown of the retained portion by originating EU-country (Panel B) reveals that the retained portion is greatest for Italy (with 15.2% mean value).

A breakdown of the retained portion by the chosen retention option (Panel C) 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%.

We run regressions to formally test the influence of the type of underlying assets, the originating country, and the chosen retention option on the retained portion in a transaction. Table 4) shows the results of four models: In Model 1, the retained portion is regressed on dummy variables of different underlying assets classes. The dummy for residential-loan transactions is excluded from the regression. Thus, all coefficients show effects compared to residential-loan transactions. It can be seen that consumer-loan and SME-loan transactions are associated with significantly more retention than residential-loan transactions. In Model 2, the retained portion is regressed on dummy variables capturing the originating country. The five biggest originating countries are included in the regression. Correspondingly, the obtained coefficients show the effects of each of these countries compared to all other countries in the sample. It can be seen that transactions originated in Italy are associated with significantly more retention than other countries. In Model 3, the retained portion is regressed on the chosen retention option. The dummy variable for retention option 1 (vertical retention) is excluded from the regression and thus captures the basic effect. It can be seen that the choice of retention option 4 (first loss retention) is associated with a significantly higher retained portion.

In Model 4, all variables from Models 1-3 are included. It can be seen that the significant effects of the consumer-loan dummy, the SME-loan dummy, and the dummy for retention option 4 on the retained portion persist. The effect of the dummy for deals originated in Italy vanishes. This can be explained by the fact that most consumer-loan transactions are originated in Italy. Thus, the dummy variable for consumer loans seems to contain the effect.

The descriptive study of the European STS market shows some similarities and some differences to the US market, where the latter is discussed in Furfine (2020) and Flynn et al. (2020). Notably, the vertical and the horizontal option are both chosen frequently, about 43.4% and 46.8%, respectively. Interestingly, if it comes to first loss retention, the EU legal minimum of 5 percent turns out to be non binding, on average. The other available options, to the extent they are chosen at all, are binding.

Knowing the type of retention option chosen does not exhaust the available information. A fuller picture of the actual risk retained is needed to allow the issuer to assess incentive alignment. In order to improve the risk retention information provided to investors, we propose a simple metric that allows to compare effective risk retention across issues using a single number/value.

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

3.1 The Retention Metric

In this section we will develop a simple metric that captures the extent to which the issuer retains skin-in-the-game, by retaining a certain portion of the securitization transaction. The basic idea is to measure the magnitude of potential default losses that is included in the retained 5%, according to the retention option chosen by the issuer.

The goal is to achieve a suitable, incentive-conscious retention metric. This metric should be based on retained (expected) default losses as a manifestation of the skin-in-the-game (rather than the nominal value of the retained portion). Thus, we propose the retention metric $\mathcal{RM}$, capturing the *portion of overall portfolio losses that is retained by the originator*. In other words, effective retention is given as the expected loss of retained exposures weighted by its value, relative to total expected loss. Formally, it can be 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), both for the case of prudent monitoring. Thus, $\mathcal{RM}$ captures the size of the default loss retained by the issuer together with the likelihood of the loss event occurring.

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 values 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. It is easy to understand and it is normalized to the interval between zero (for no retention at all) and one (for full retention), i.e. the metric rises with the extent to which default losses are retained. A closely related metric 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, tend to be very small. Hence, the retention of a senior tranche, or parts thereof, will have very limited, if not zero positive incentive effects.

3.2 Applying the retention metric to the proposed 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 –in the US– also for combinations of those two basic alternatives. Moreover, the EU regulation also admits three additional options, namely 5% of every single exposure, 5% of randomly selected exposures, and 5% first loss 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 is large, approaching the nominal value, if expected loss is small, and vice versa.

To present a simple numerical example, Table 6 shows the retention metric for the most prominent options. Assume that a transaction consists of two tranches only, 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 5% vertical retention, i.e. 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 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 expected loss for the same obligatory retention level.

As 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 7). The upper part of the table has the 5 options according to the EU regulation, and the lower part shows the 3 options offered to US issuers. The numbers in Table 7 show how the retention options differ between the EU and the US when it comes to nominal retention, and it shows how effective retention differs between the different options even within one regulatory framework. For simplicity, and without loss of generality, when referring to fair values we will rely on expected values, assuming risk neutrality in valuation.

Overall, the US regulation is more strict than regulation in the EU, since a 5% retention based on junior tranche fair values implies larger effective default risk retention under than an otherwise identical regulation based on face values.

The retention metric $\mathcal{RM}$ takes the value 5% for retention options EU(a)-(c), and also for option DF(a). These option all imply forms of vertical retention, i.e. 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, i.e. option EU(d) and DF(b), $\mathcal{RM}$ takes higher values, ranging from 5% up to 100%. This implies that horizontal retention is always associated with a higher fraction of loss retention than 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 values higher than 5%. Finally, option EU(e) also implies a form first loss retention. Thus, the retention metric $\mathcal{RM}$ takes values 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.

Next, we consider option EU(e). 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) turns out to be 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 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), i.e. option DF(c), allows to target any desired level of the retention metric between the horizontal and vertical option through an appropriate choice of weights.

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

Overall, Table 7 provides a general comparison of the retention options for both regulatory regimes. The table shows numbers for the retention metric $\mathcal{RM}$ and ranges for $\mathcal{RM}$ where these numbers may vary. The exact numbers depend on the loss distribution of the reference portfolio and thus typically differ from transaction to transaction.

3.3 Applying the retention metric to a real-world example

Next, we determine the level of effective retention for a real-world example of a synthetic CLO transaction: Deutsche Bank's London Wall 2002-2 transaction.

We refer to a widely used methodology to estimate the loss distribution of a portfolio. The methodology is used, e.g., by rating agencies in their evaluation of asset backed securities, and by investment banks in their advisory work on the structuring of asset portfolios for securitization purposes. The obtained portfolio loss distribution will serve as basis to determine the value of the retention metric under different retention options.

Information on the transaction is given in Moody's new issue report (Moody's (2002)). 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 twelve tranches of different seniority, except for tranches A1 and A2 as well as B1 and B2 which have the same seniority, but different currencies. Of these twelve tranches, eleven 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, i.e. the first loss piece, amounts to a comparably tiny 2.61% of the nominal value.

We refer to the offering circular regarding the composition of the reference portfolio.

We apply the information provided to estimate the loss distribution of the portfolio by means of 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. number of loans, number of different obligors, maturities, exposure sizes, loan ratings, industry composition, diversity score etc.). Data on rating migrations and recovery rates is taken from Moody's tables. Based on this input data, default scenarios are generated for all individual obligors. Aggregating these simulation results leads to a loss distribution of the entire portfolio.Figure 2 shows the resulting loss distribution of the London Wall reference portfolio, assuming the standard simulation parameters as utilized by Moody's rating calculations. The simulations rely upon the standard assumptions used by Moody's for this transaction, namely a uniform bi-variate 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.

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. This means that small losses do occur and are quite likely, while large losses essentially do not occur. This structure leads to a rather small first loss piece where 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 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 depicted in the figure. The retained first loss piece amounts to 5% of portfolio face value, while the securitized portion amounts to the remaining 95%.

The first loss piece contains the major part of the risk, while the more senior portion is protected by the more 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 rarely is hit. Correspondingly, the first loss piece has 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, due to the principle of subordination implied by horizontal slicing.

Table 8 presents comparative results of the retention metric for 8 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 EU and US rule, 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 rule; a linear combination of both is DF(c), the so-called L-shape.

The estimation results reported in Table 8 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, i.e. the assumptions concerning 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).

From left to right, the table reports the name and description of the different retention options, the corresponding value convention (nominal value or fair value), the size of the retention in terms of the regulatory standard (nominal value or fair value), the size of the retention in terms of the effective nominal holding, the expected loss of the retained piece and, lastly, the retention metric $\mathcal{RM}$ which captures the share of retained losses.

Note that the retention metric is our key variable. As can be seen from the last column in Table 8, 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 irrespective 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 8. The retention metric $\mathcal{RM}$ takes values much larger than

5%. In the base case, $\mathcal{RM}$ is equal to 99.86% - twenty 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 and low variance, 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 8).

If applied to the London Wall case, EU(e) in Table 8 yields a value of the retention metric of 8.81%. 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%, very close to the 5% covered by the retention rule. The value of the retention metric is inversely proportional to loss per loan, conditional on default, i.e. it is high for low LGDs and vice versa, reaching 100% for LGD values of 5% and less.

Turning to the rules under Dodd Frank act, we look at lines 6 to 8 of Panel A in Table 8. Again, the same underlying securitized loan portfolio is assumed, London Wall 2002. The main difference between the European and the American approach 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, fair value of a financial instrument is approximated using its expected value under risk neutrality, where repayment expectations reflect default risk and loss given default from the very Moody's tables that were used to structure the transaction at the time of issuance.

The question is whether the use of fair values has an impact on the retention metric. A comparison of DF(a) with EU(a) in Table 8 shows the equivalence of the vertical slice under both regulatory regimes. However, a comparison of EU(d) with DF(b), i.e. 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 8. Changing the parameters of the basic simulation model does not change the resulting retention metrics by much. All qualitative results remain unchanged.

While we apply the London Wall transaction as base case for this exposition, we also show that the findings are not specific to this particular case. As additional robustness check, we apply the presented modeling techniques to other transaction examples and repeat the calculations. The results in Table 9 show that the implications are the same.

4 Implications for policy makers, regulators, and rating agencies

In this paper, we suggest a simple measure to capture effective risk retention in ABS transactions. The retention metric $\mathcal{RM}$ expresses the share of expected losses retained by the originator in a single number, ranging from zero to one, i.e. from a low of zero expected loss retention to full loss assumption.

When applying our retention metric to major admissible options under the existing regulatory regimes in the EU and the US, we find that, for the same securitization transaction, effective retention can be very small (smaller or equal to 5%) under one option and very large (close to 100%) under another option. This in itself is an irritating finding, given that a sufficiently elevated level of risk retention is the explicit objective of the regulation in both constituencies. This leads to the central question: If the options imply very different retention levels, and if issuers can self-select, then what has the regulation actually achieved in terms of public disclosure concerning originator/issuer deductible?

The answer to the above central question is ambiguous: despite wide-ranging effort in defining and mandating minimum retention requirement for issuers and originators, both in the US and in the EU, a variety of distinct options have emerged that may show significantly different levels of actual loss retention. In this regard, the European evidence shown in this paper complements the US evidence in Flynn et al. (2020) and Furfine (2020) in an important way: retention size is shown to vary significantly across and within options, from low levels to high levels way beyond the required minimum. We also find a systematic pattern relating to option choice, with the underlying assets playing a dominant role.

This is in stark contrast to the US evidence, where minimum requirements are reportedly binding throughout the sample, while in Europe we find minimum requirements to be non-binding in the majority of cases, particularly if it comes to the horizontal option - which is also the most preferred option among all.

This evidence suggests a demand for flexibility in retention levels, questioning the prescription of a flat 5% rule for all available options.

Under the current regulation, only horizontal retention fulfills the expectation of a significant deductible for the issuer. This holds true for the pure horizontal retention options EU(d) and DF(b), and to some extent for the mixed options EU(e) and DF(c). Thus, if the objective of the ABS retention rules is to tie risk incentives to the originator, by giving him/her a significant ex-ante stake in ex-post risk realizations, then the pure horizontal retention options EU(d) and DF(b), respectively, are more convincing than any of the other existing alternatives.

On a deeper level, the uneasiness with the current state of retention regulation is due to the lack of user-friendly, concise disclosure and transparency. Investors simply do not know the actual retention level of a given transaction and will therefore have a hard time understanding the implications for the originator's behavior.

In order to improve the information level in securitization markets, knowledge of retention option choices do not suffice any longer. Therefore, policy could opt for increased transparency with respect to the size and the expected loss of retained tranches. While the size information can sometimes be distilled from the offering circulars, a measure of effective retention that takes into consideration the statistical properties of the loss distribution is not available today. The metric we are proposing in this paper thus fills a void. It could, if disclosed publicly, allow the market to price the financial instrument properly, taking due consideration of possible incentive problems.

The triple describing the option by type, size, and effective retention, e.g. $\mathcal{RM}$, may be a reasonable mix to enhance transparency in securiitization markets, without creating excessive gaming potential. A prescribed minimum retention level, e.g. 5%, is not necessarily required.

That said, a credible $\mathcal{RM}$-based regulation needs to find a way how to render the estimation procedure unbiased, replicable, and free of conflicts of interest. One way to do this is via mandating regulators to approve securitization models used by the agencies. Similar concerns have been raised repeatedly against agency ratings, and they were typically resolved by reference to reputational capital of these agencies.

As far as implementation of a mandatory retention metric is concerned, market institutions and regulatory institutions both could play a role. On the market side, rating agencies can do the math and disclose $\mathcal{RM}$. This is a model-based exercise, and agencies are particularly well prepared to carry out such a task during the issue process. Note that models to determine the portfolio loss distribution, which are needed for calculating $\mathcal{RM}$, have been developed and applied since the 1990s by all major rating agencies, e.g. Moody's and Standard & Poors, see Cantor et al. (2002). $\mathcal{RM}$-values could be published by the agencies prior to the initial public offering, and updated regularly, along with further rating information. The market regulator ESMA could oversee the agencies with respect to the quality of their $\mathcal{RM}$ assessment.

Once implemented, the proposed retention metric would allow issuers to use own interest as a signal to investors, potentially enhancing 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: Empirical results - comparison of 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). 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: Breakdown of retention options in EU transactions

This table presents empirical results on the number of transactions in the EU under the new legislation (i.e. CRD IV) by chosen retention option, broken down by type of underlying assets in the transaction (Panel A) and by originating country (Panel B). The data for the EU is extracted from official filings submitted to ESMA during the time period from March 22, 2019 to January 27, 2021. The columns indicate the chosen retention options, and the rows indicate the underlying assets (Panel A) and the originating country (Panel B).

Panel A1: Retention option by type of underlying assets

	Retention option				
Underlying assets	EU(a) vertical slice	EU(c) random exposures	EU(d) horizontal slice	unclear	Total
auto loans/leases	5	21	18	3	47
consumer loans	9	3	10		22
credit-card receivables			1		1
leases			4		4
others			1		1
residential loans/mortgages	6		34		40
SME loans	1		4		5
Total	21	24	72	3	120

Panel A2: Retention option by type of underlying assets - relative

	Retention option				
Underlying assets	EU(a) vertical slice	EU(c) random exposures	EU(d) horizontal slice	unclear	Total
auto loans/leases	23.8%	87.5%	25.0%	100%	39.2%
consumer loans	42.8%	12.5%	13.9%		18.3%
credit-card receivables			1.4%		0.8%
leases			5.6%		3.3%
others			1.4%		0.8%
residential loans/mortgages	28.6%		47.3%		33.3%
SME loans	4.8%		5.6%		4.2%
Total	100%	100%	100%	100%	100%

Panel B1: Retention option by originating EU-country

	Retention option				
Originating country	EU(a) vertical slice	EU(c) random exposures	EU(d) horizontal slice	unclear	Total
BE			2		2
DE	2	13	12	3	30
ES	3	6	3		12
IE	2				2
FI		2			2
FR	2		19		21
IT	7	1	14		22
LU	1				1
NL	4	1	21		26
PT		1	1		2
Total	21	24	72	3	120

Panel B2: Retention option by originating EU-country - relative

	Retention option				
Originating country	EU(a) vertical slice	EU(c) random exposures	EU(d) horizontal slice	unclear	Total
BE			2.8%		1.7%
DE	9.5%	54.2%	16.7%	100%	25.0%
ES	14.3%	25.0%	4.2%		10.0%
IE	9.5%				1.7%
FI		8.3%			1.7%
FR	9.5%		26.4%		17.5%
IT	33.3%	4.2%	19.4%		18.3%
LU	4.8%				0.8%
NL	19.0%	4.2%	29.2%		21.7%
PT		4.2%	1.4%		1.7%
Total	100%	100%	100%	100%	100%

Table 3: Logit regression analysis of retention option in EU transactions

This table presents logit regressions for the different retention options in EU transactions. The choice of a particular retention option is regressed on dummy variables capturing the originating country, the type of underlying assets, and both.

	Option 1 country	Option 1 asset class	Option 1 both	Option 3 country	Option 3 asset class	Option 3 both	Option 4 country	Option 4 asset class	Option 4 both
dummy_IT	1.0296*		0.4585						
	(1.90)		(0.75)						
dummy_consumer_loans		1.6017***	1.4274**						
		(3.01)	(2.46)						
dummy_DE				2.4128***		1.2417*			
				(4.08)		(1.88)			
dummy_ES				2.6810***		2.5119***			
				(3.62)		(2.89)			
dummy_auto_loans					2.9363***	2.5859***			
					(4.46)	(3.39)			
dummy_FR							2.4991***		2.3379***
							(3.20)		(2.95)
dummy_NL							1.6829***		0.7842
							(3.06)		(1.19)
dummy_residential_loans								1.8347***	1.5209***
								(3.70)	(2.58)
Constant	-1.7918***	-1.9694***	-2.0292***	-2.6810***	-3.1499***	-3.8049***	-0.2478	-0.1001	-0.4698*
	(-6.21)	(-6.39)	(-6.30)	(-5.80)	(-5.34)	(-5.32)	(-1.05)	(-0.45)	(-1.84)
Observations	120	120	120	120	120	120	120	120	120
Pseudo R^2	0.030	0.078	0.083	0.210	0.254	0.335	0.141	0.105	0.187

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Breakdown of the retained portion in EU transactions

This table presents summary statistics on the retained portion in EU transactions under the new legislation (i.e. CRD IV), broken down by type of underlying assets in the transaction (Panel A), by originating country (Panel B), and by the chosen retention option. The data for the EU is extracted from offering circulars of transactions which filings were submitted to ESMA during the time period from March 22, 2019 to January 27, 2021. The columns indicate statistics on the retained portion (number of deals, mean, median, and standard deviation), and the rows indicate the type of underlying assets (Panel A), the originating country (Panel B), and the chosen retention option (Panel C).

Panel A: Retained portion by type of underlying assets				
underlying assets	N	mean	median	std
Auto loans/leases	29	0.087	0.070	0.053
Consumer loans	12	0.113	0.093	0.079
Leases	3	0.091	0.082	0.016
Residential loans/mortgages	25	0.070	0.050	0.025
SME loans	2	0.312	0.312	0.082
others	1	0.050	0.050	.
Total	72	0.091	0.070	0.063
Panel B: Retained portion by originating EU-country				
originating country	N	mean	median	std
BE	2	0.092	0.092	0.018
DE	21	0.076	0.079	0.031
ES	5	0.060	0.065	0.010
FR	12	0.103	0.081	0.067
IT	14	0.152	0.123	0.096
LU	1	0.050	0.050	.
NL	16	0.061	0.050	0.033
PT	1	0.090	0.090	.
Total	72	0.091	0.070	0.063
Panel C: Retained portion by retention option				
retention option	N	mean	median	std
1 (vertical slice)	8	0.050	0.050	0.000
3 (randomly selected exposures)	11	0.062	0.054	0.015
4 (horizontal slice)	53	0.104	0.080	0.070
Total	72	0.091	0.070	0.063

Table 5: OLS regression analysis of the retained portion in EU transactions

This table presents OLS regressions for the retained portion in EU STS transactions. The dependent variable (retained portion) is regressed on dummy variables indicating the type of underlying assets (Model 1), the originator country (Model 2), the chosen retention option (Model 3), and all variables (Model 4). The sample covers all transactions where filings were submitted to ESMA to obtain STS status and where the retained portion could be extracted from the offering circular.

	(1) Underlying Assets	(2) Originating Country	(3) Retention Option	(4) Full Model
dummy_auto_loans	0.0154			0.0219
	(1.15)			(1.46)
dummy_consumer_loans	0.0415**			0.0457**
	(2.40)			(2.23)
dummy_others	-0.0218			-0.0047
	(-0.43)			(-0.09)
dummy_SME_loans	0.2399***			0.2043***
	(6.53)			(5.62)
dummy_DE		-0.0044		-0.0244
		(-0.14)		(-0.91)
dummy_ES		-0.0204		-0.0422
		(-0.54)		(-1.25)
dummy_FR		0.0224		-0.0066
		(0.69)		(-0.25)
dummy_IT		0.0712**		0.0105
		(2.24)		(0.36)
dummy_NL		-0.0197		-0.0318
		(-0.63)		(-1.27)
dummy_option_3			0.0122	0.0361
			(0.43)	(1.37)
dummy_option_4			0.0535**	0.0643***
			(2.33)	(3.32)
Constant	0.0718***	0.0808***	0.0500**	0.0325
	(7.57)	(2.89)	(2.33)	(1.23)
Observations	72	72	72	72
R^2	0.407	0.273	0.108	0.588

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Retention metric - example

This table presents a simple example on how the retention metric is calculated for the 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 7: 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 8: Retention metric (London Wall)

This table presents, for a real-world transaction (London Wall 2002-2), 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, 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 sir value	5%	7.2%	30.7%	95.84%	95.84%
DF c)	5% L-shaped slice (50%-50%)	fair value	5%	6.1%	16.5%	43.70%

Table 9: Retention metric

This table presents, for the base case example, 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, size of retention, mean loss of retained portion, and retention metric. In Panel A (base case), the reference portfolio consists of 10'000 zero bonds, and all of them are assumed to have a default probability of 7.63%, 10 years maturity, 24.15% recovery rate, and a default correlation of 0.15. The loss distribution is calculated with 500'000 simulations. In Panel B, the base case is altered and the default correlation is increased to 0.3. Panel C applies the portfolio characteristics of the base case, except the default probability, which is increased to 19%. In Panel D, the settings of the base case are applied, with the exception that the number of loans in the reference portfolio is 100.

Panel A: Base case				
Regulation	Description	size of retention	mean loss	Retention metric
EU a)	5% of each tranche	5%	5.79%	5.00%
EU b)	5% of each individual exposure	5%	5.79%	5.00%
EU c)	5% of randomly selected exposures	5%	5.79%	5.00%
EU d)	5% horizontal slice (first loss)	5%	69.01%	59.55%
Panel B: Different correlation ($\rho = 0.3$)				
Regulation	Description	size of retention	mean loss	Retention metric
EU a)	5% of each tranche	5%	5.80%	5.00%
EU b)	5% of each individual exposure	5%	5.80%	5.00%
EU c)	5% of randomly selected exposures	5%	5.80%	5.00%
EU d)	5% horizontal slice (first loss)	5%	60.11%	51.82%
Panel C: Different default probability (p=0.19)				
Regulation	Description	size of retention	mean loss	Retention metric
EU a)	5% of each tranche	5%	14.42%	5.00%
EU b)	5% of each individual exposure	5%	14.42%	5.00%
EU c)	5% of randomly selected exposures	5%	14.42%	5.00%
EU d)	5% horizontal slice (first loss)	5%	73.83%	25.60%
Panel D: Different number of loans (100 loans)				
Regulation	Description	size of retention	mean loss	Retention metric
EU a)	5% of each tranche	5%	5.79%	5.00%
EU b)	5% of each individual exposure	5%	5.79%	5.00%
EU c)	5% of randomly selected exposures	5%	5.79%	5.00%
EU d)	5% horizontal slice (first loss)	5%	66.45%	57.36%

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.

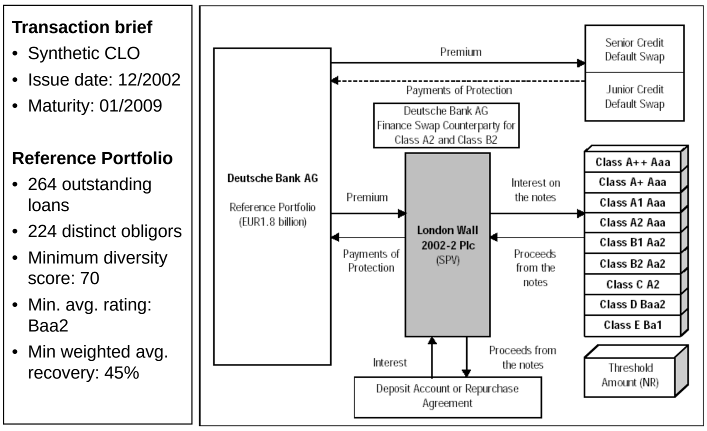


Figure 2: Real-world tranching example: The London Wall 2002-2 transaction

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).

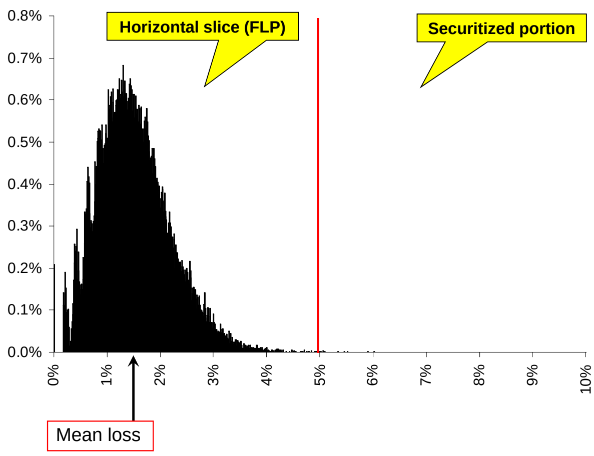
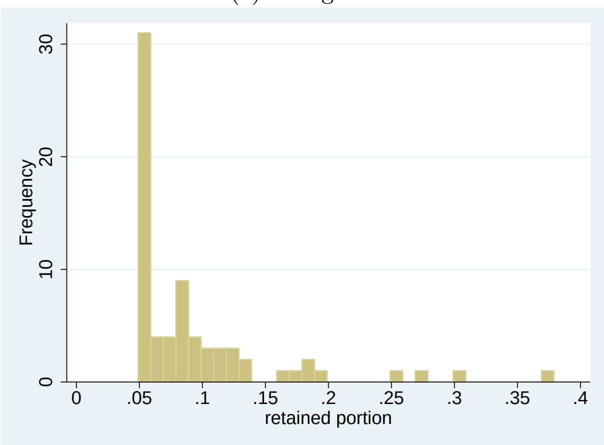
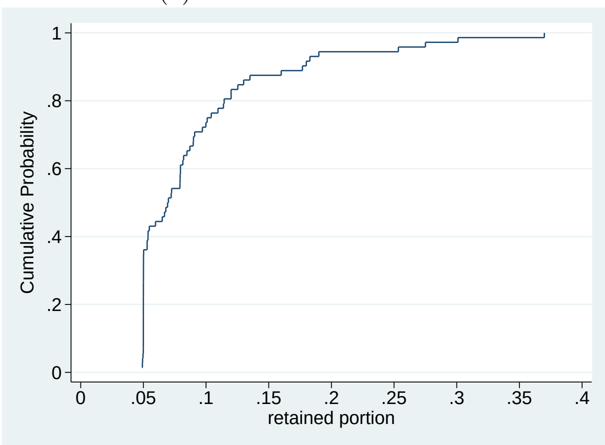


Figure 3: Statistics on the retained portion

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.





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