Calibration of the Securitisation Risk Weights with Capital Neutrality

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**Abstract**

This paper presents a new calibration for the Risk Weights of securitisation instruments using the principle of capital neutrality. By design, the sum of the capital requirements on all the tranches of a securitisation transaction is equal to the capital requirement of the relevant pool to achieve capital neutrality. The capital allocation on tranches is thus arbitrage-free and results from the capital model of the regulator on the pool. This allocation is simplified with a closed form formula in order to be easily implementable by both investor and originator banks. The capital allocation is defined first for an infinitesimal tranche and then for any tranche. The formula simply results from the IRB model, it can be estimated in an excel spreadsheet. It is aimed at the banking regulator for the revision of securitisation risk weights, and it intends to replace SEC-IRBA formulas. However, those results are not limited to the SEC-IRBA method: SEC SA calculation will be easy to derive from this approach, and the SEC ERBA and IAA methods will have to be adjusted in accordance as well in order to ensure consistency between methods and to reduce any opportunity of arbitrage.

Keywords: Securitisation, Risk Weighted Assets, Basel Committee, SEC IRBA, Capital Neutrality

**Introduction**

In December 2022 the advice of the Joint Committee of ESAs on securitisation highlighted the problem posed by the absence of capital neutrality on securitisation transaction: ***“Capital non-neutrality*** *embedded in the framework […] has been considered too high in relation to the lower agency and model risk featured by securitisations post the global financial crisis thanks to several supervisory (TRIM, SREP) and regulatory initiatives (EBA IRB repair, STS framework, SECR and output floors, though the latter are not yet in force).”*

This non-neutrality of capital measure for securitisation leads to a regulatory impasse, acknowledged by the ESA, which in turn ask for a complete revision of the shape of the RW function: ***“Conflicting goals within the halfpipe design****. It is understood that legislators targeted different goals and effects with the formula-based approaches. First, to reduce cliff effects. Second, to ensure a deduction of capital as high as the capital before securitisation. Third, to avoid an unreasonable level of capital non-neutrality. This represents a* ***conflict of objectives****, as one can only achieve two out of these three goals within the current halfpipe design. All three goals cannot be reached simultaneously […] This finding of the conflicting three goals suggests for an open discussion on the shape of the RW function.”*

In order to define a new shape for the RW function for securitisation, we propose to develop a new quantitative approach, with an emphasis on capital neutrality and non-arbitrage properties. We come back to the origin, looking for a model on securitisations that is consistent with IRB models. In particular, we have tried to find parameters that could allocate the capital on a securitisation tranche using the same IRB formulas as the underlying pool, with only an adjustment of the PD and of the correlation of the IRB framework. Although we have used a few simplified hypothesis, assuming no recoveries and one-year maturity and using an equally distributed pool, our result illustrates the strong increase of implied correlations on this capital allocation, highlighting the nonsense of using securitisation formula for re-securitisation. The shape of the capital allocation follows the inverted S curve also mentioned in 2022 by the advice of the Joint Committee of the ESAs and by the papers from Duponcheele (2023) or from Perraudin (2020). We favour the capital-neutrality approach to allocate the on the securitisation, and we propose simplified formulas of the inverted S curve that fit the proposed modelling.

This proposal comes at a time when we can see a strong momentum toward the development of securitisation markets of high quality in Europe, and since the ECB (Lagarde 2023) mentions securitisation as a key component of the Capital Market Union. We hope this easy-to-use toolkit will help regulators (in Europe but also at the Basel Committee) revisit the Risk Weight function for securitisation (estimated for SEC-IRBA, but that should be applied as well to SEC SA, IAA and ERBA methods) and reduce the non-neutrality components that have proved very damaging to European securitisation.

# The model on assets, based on the regulatory model for RW on the pool

In order to avoid any kind of arbitrage in the setup of banking supervision we will start from the modelling that is implicit in the regulatory formulas for IRB pools (and that was explicitly demonstrated in Gordy’s papers). We have concentrated our work on the main two Basel Portfolios: Corporate and Retail, but the results are easy to generalise to other pools.

The distribution of the 1-year losses is described using the macroeconomic global risk factor I (or systemic risk factor), and the distribution of losses conditionally on the value of I:

With[[1]](#footnote-1): factor I is a uniform law in [0,1] and such that G(I)~N(0,1)

LGD being the value of the Loss Given Default

being the 1-year probability of default of the pool

R being the correlation parameter from IRB regulatory framework

As a reminder, the Risk Weighted Assets -as defined in the Basel framework for Banking regulation- are based on the 99.9% percentile of the distribution of Loss(I), we will call it “*the IRB formula*”:

In the IRB framework, the yearly Expected Loss component is deducted from the Common Equity Tier One, which is equivalent (in term of CET1 ratio) to a Risk Weight of 1250% for a bank having 8% CET1 ratio[[2]](#footnote-2). As a consequence, to avoid double counting, the 1-year Expected Loss () component is removed from the RW. The Loss is estimated at the one year horizon on the capital of the transaction only which means that the future income is not taken into account, neither in the calculation of the loss, nor in the potential future increase of the CET1. This is rather conservative with regard to the CET1 ratio since at origination, and as long as the transaction remains on the same level of risk, the inclusion of future income covers each year the Expected Loss plus the remuneration of the risks (measured through RWA) plus any operating or refinancing costs. It is thus significantly more favourable for the CET1 ratio to include future revenues (net of costs), even if one were to estimate a risk on those future revenues (usually designated as a business risk in the pillar 2 framework) since the main component of the Expected Loss (the first year) is already deducted from CET1. We will keep the same approach in our modelling on securitisation tranches, having in mind that we want to avoid regulatory arbitrage. We also focus on 1-year transaction first before discussing the introduction of maturity effects for longer transactions. This is also consistent with the modelling choice made by the Basel Committee on securitisation for the Basel 2 and the Basel 3 framework.

The correlations used by the regulatory framework depends on the type of products. We illustrate our proposal on the Corporate and the Retail portfolio for which the correlation follows a certain dependence on the PD:

For the Corporate portfolio:

For the Retail portfolio:

Our approach can easily apply to SME, real estate, specialised lending and revolving retail portfolio, however it would require another modelling for NPL or for Equity.

In addition, as a reminder, the regulatory formulas assume infinite diversification of the pool. In the initial working paper of the Basel Committee the addition of an adjustment for granularity was discussed. It was finally not included in the regulatory framework in order to ease calculation (its impact is debatable since it depends on the consolidation perimeter and could lead to unexpected capital allocation between subsidiaries). We will assume that we are always under the hypothesis where we do not have any granularity impact.

# From the modelling of the pool to the modelling of the tranche

In this section we will assume that we look at a portfolio of assets with maturity below or equal to one year. In this case, we will adopt the same conservative measure as the one used in regulatory formulas, assuming one-year maturity on the calculation. We will also assume that the LGD is a fixed value of 100%, in order to simplify the formulas, but also because the current capital framework does not envisage the variability of the LGD or the use of the distribution of recoveries in the risk weight calculation. We actually discuss the impact of the distribution of recoveries in the paper *“Rethinking the Design and Calibration of the Securitisation Risk Weight Floor”* from Duponcheele (2024), and think that it could be properly taken into account through the introduction of a floor on risk weights.

The core step of our approach consists, for a given tranche of securitisation, in looking for the value of R and of PD that fits the tranches in order to define the Risk Weight on the tranche using the same formula as the pool.

## The binomial conditional distribution

Starting from the loss distribution on the portfolio:

We can define similarly the conditional probability of default on the pool:

(1)

We would like to be in a situation where we could apply the hypothesis of infinite diversification, however in order to be able to perform the calculations, we will assume that the portfolio consist of n loans of equal value, n being large enough in order to be close to the infinite diversification hypothesis but not too high. We have in fact performed the calculation with two values (n=60 and n =80), leading to a similar result.

If we reason conditionally on the factor I (“knowing I”), the defaults are independents. In this case the loss distribution will follow a binomial distribution:

We will use this property in order to define the distribution of losses on the tranches of a securitisation.

## Looking for the average PD and the implicit correlation on the tranche

The probability that we observe more than x defaults in the portfolio with n identical loans (knowing I) is thus given by the cumulative distribution:

The probability (knowing I) that a tranche with a credit enhancement of *CE* will default is thus:

Note that we do not take into consideration any recovery on the tranche.

This calculation can be done in Excel as long as the value of n is not too high, and for a statistically representative set of values of I. It is thus possible to estimate the average PD of the tranche, for all possible values of I:

And using all the set of values for I, we can look for the value of , which is the level of correlation that best fits the variability of the default rates of the tranche, for example using a min square fit[[3]](#footnote-3):

Those values were estimated with a discretisation of the value I along 1000 uniformly representative samples. With the increased value of CE, the value of can be very small, leading to calculation difficulties, and the impossibility to estimate . However since it corresponds to the higher tranches, we have added a constrain on the value of :

This last hypothesis leads to the following curves for a pool with 1% PD:



Figure 1: correlation corporate Figure 2: correlation retail

The curves of for this same hypothesis behave exponentially, with a rapidly decreasing value of PD on the tranche:

 

Figure 3: tranche PD for corporate pool Figure 4: tranche PD for retail pool

We have similar results with a large set of values for the PD of the pool, ranging from 0.2% to 10% (see Zana, Frédéric 2023 for a short analysis of the evolution of those results with the PD). Three conclusions can be drawn from those results:

* The PD of the tranche decreases very rapidly with the CE, and this is linked with the correlation hypothesis. A higher correlation leads to higher default rates for lower tranches but converges more rapidly to a low default rate for higher tranches
* The implied correlation measures on tranches is significantly higher than the correlation of the portfolio. After securitisation the correlation structure, measured on the sole systemic risk factor I, is significantly higher than on the portfolio. Starting from levels below 25% we have more than 70% correlation on the higher tranches: it is thus not possible to apply the same approach for a portfolio of securitised tranches. In other words, re-securitisation should be excluded from such an approach: if we had started with a portfolio with 70% correlation, we would have rapidly found that no diversification of risk (measured at the 99.9% percentile) is possible.
* We have all elements to apply the IRB formula on the tranches and check if this is a capital-neutral allocation. However, since we did not take into account the recovery of the tranche, we can expect to have an allocation that is slightly higher than the capital of the pool (although a decomposition into small tranches will reduce significantly this approximation).

## Checking the capital-neutrality

One important feature of this approach is whether the resulting allocation respects the capital neutrality principal. We have thus estimated the ratio between the sum of the capital allocated to the tranches[[4]](#footnote-4) based on () and the capital of the pool, based on (). We have used a discretisation of the tranches with 1% thickness on the lower tranches.



Figure 5: comparison model vs RWA corporate Figure 6: comparison model vs RWA retail

We can see that the capital neutrality is relatively well respected, considering that the lower PD levels are more difficult to assess.

# The calibration of a simplified formula

Once we have recovered the parameters (PD, Correlation) for a tranche of securitisation transaction, we can allocate the capital using *the IRB formula*. However, the process to estimate those values is long, hence we have looked for a simplification, bearing in mind that we would like to achieve capital-neutrality in this simplified formula.

## The simplified formula

In order to define the simplified formula, we have looked for a symmetry around the , with a value close to 1250% when the Credit Enhancement (“CE”) is close to zero, and 0% when the Credit enhancement is relatively high ( ). Since we base our fit on a set of simulations, the symmetry around the was a predominant constrain of this fit, before adjusting for A and B, in order to achieve capital neutrality by construction. We have found the following values, as a function of the CE, the and the PD:

(2)

The values of A and B that we have found depend on the level of the PD on the pool. We have found the relationship:

Corporate: Retail:

B B

 

Figure 7: fit model vs simplified curve (corporate) Figure 8: fit model vs simplified curve (retail)

Resulting RWA compared to the current RWA:



Figure 9: comparison of our proposal with current and discussed securitisation RWA

## Impact of the size of the tranche

The simplified formula (2) has been calibrated on a tranche of small size (we have used steps of 1% to derive the curve). In order to apply this formula on a tranche of any size, it would necessitate an integration.

One approximation would be to use the risk weight of the attachment point: a tranche with attachment point and detachment point would have the Risk Weight of from formula (2), which is conservative and would guaranty that the result is not capital –neutral. This method corresponds to the way some rating agencies rate, based on the probability of any loss, but not all rating agencies (Moody’s and Scope for example base their rating on the Expected loos rather than the probability of any loss).

Alternatively, we propose to rely on the integration of the simplified formula, using the cumulative normal inverse, which ensures capital-neutrality. Considering a tranche with attachment point and detachment point, we should have:

If we take:

Where is the cumulative of the Gaussian distribution.

We can deduct all the configurations for attachment point and detachment point, from the two integrals passing through .

When :

When :

Where coefficients and are defined as a function of as in (2).

As a result, for all configurations:

and :

and :

and :

## Maturity effects

Maturity effects for IRB formulas have been explained in Gordy 2002, especially we refer to formula (14). They result from a Mark-to-Market impact at the one year horizon, which is the risk horizon that is used to define the Risk Weights on credit risk in the IRB framework. They have been calibrated using CreditMetrics and KMV Portfolio Manager at that time (see Gordy 2002 and 2003), and their impact can be easily deduced from the one-year transition matrix used.

At this stage, we have dealt with the default risk that happens during this one-year horizon. IRB formula only introduce maturity effects in a few cases, on the Corporate portfolio. We can thus assume that each transaction has a rating (internal or external) with an associated one-year PD but also with a one-year migration matrix. If we assume, to simplify, that loans are like zero-coupons and that their spread are just linked to their rating, then the valuation at horizon is simplified:

Where:

is the valuation at horizon without any rating change (,

is the valuation at horizon for the rating

t is the maturity of the loan

is the reference of the interest rate of the loan at horizon

is the spread of the loan for the rating

EAD is the exposure of the loan.

is the coupon assumed paid in-fine[[5]](#footnote-5), it is calibrated so that

For simplification purpose, we will use

Depending on the rating, in addition to the credit loss in case of default we will have a MtM loss (or gain) due to the rating change without default at horizon. Using first order approximation, we have :

If we assume that we have a rating grid with i= 1 to N, 1 being the best rating and N being the default, with average one-year transition rates from , then with we can approximate the expected loss with MtM effect[[6]](#footnote-6):

Note that we will assumed like previously done that . In addition, the approximation can be generalized for the conditional expectation on a stress scenario (or “knowing I”), with a formula similar to (1):

Assuming LGD =100% like for previous calculations (and note that the LGD assumption is not independent from the level of spread used for the valuation), we have:

As we can see, at the first order we have an affine function of t, whose slope is very similar to the one used in IRB formula. As mentioned by Gordy (2002), they were based on regressions on KMV or Credit Metrics simulations. Even though our formulas are approximate, it provides an interesting impact of the change in correlation induced by the process of securitisation. The change in the slope of the expected loss (knowing I) is linked to the change in the following component with R:

We can thus compare the slope of the pool before securitisation to the slope of the tranches at various rating levels. Our estimates show that for a standard migration matrix and level of spread by ratings (for example based on average S&P migrations), the slopes before and after securitisation are lower than the slope of the regulatory curves. This is probably due to that fact that in KMV, the implied transition matrix is based on the distance to default, which implies much stronger probabilities of rating change. Using this formula we can compare the maturity slope of the regulatory formula for corporates with the slope deducted from the correlation level implied at a tranche level for a corporate portfolio. We used S&P average transition matrix for structured finance and a hypothesis of spread by ratings that increases regularly by 200bps for each large rating loss below investment grade (and slightly less for investment grade ratings).



Figure 10: maturity impacts adapted to structured finance transition

As can be seen, the maturity effects estimated, which takes into account correlation levels as high as 80%, are smaller than those used in the regulatory formulas for corporates (except for AAA level). This is a simple consequence of the high correlation: the conditional default rate tend to be quite high at the one year horizon, and thus the impact of a change of valuation in case the bond is not in default has a lower weight. For this reason, in order to respect the capital-neutrality principle and because it is already quite conservative, we would favor the use of the with maturity effect directly in the formula (2). Compared to the efficient capital allocation, this tend to increase the global level of capital for all tranches, with the exception of the senior tranche for which the maturity effect is relatively close.

## Approximations in the modelling

The proposed approach includes a number of approximations and some simplification hypothesis that are worth discussing.

The calculation assumes that we are in the condition for the infinite granularity hypothesis. This approximation is the same as the one used for regulatory calculation, it is a simplification that can be considered valid if the portfolio is large enough. Obviously, this may be a difficulty for some securitisations when the portfolio is not large (especially with a corporate portfolio). This paper does not address the case of small portfolio, however granularity effects could be dealt with different methods such as a change of the shape of the distribution which is also irregular, as can be seen in Perraudin, William (2020) “Lectures on Securitisation”. The main challenge would be to keep the capital neutrality in this scenario.

Possible solutions have been used previously in the regulation. In Regulation (EU) No 575/2013 of the European Parliament and of the Council of 26 June 2013 on prudential requirements for credit institutions and investment firms, there were a limitation on the effective number of exposures securitized: six were needed in order to be able to apply securitisation risk weights. In Michael Gordy (2002), there was a proposal to adjust the Risk Weighted Assets in order to take into account a granularity adjustment. Both of those solutions could be used in this context, together with the proposed formula (2).

Other approximations are related to the various fit of curves in order to define the model. We have constrained the formulas to be centred on to make sure that the resulting capital allocation is capital neutral, and we have rounded weights in our model. All this should have no meaningful impact on the results.

# Conclusion

We have proposed an easy-to-use closed form formula in order to allocate the capital on the tranches of a securitisation. This allocation is centred around the so that the sum of the capital allocated to the infinitesimal tranches equals the (see illustration above). It exhibits an inverted S curve similar to the one mentioned in the report from the EBA (2022) “Joint Committee advice on the review of the securitisation prudential framework (Banking)”. It relies only on two parameters, A and B, in order to change the slope around and the two rounding’s of the inverted S shape. It is designed as a first step to revisit the risk weights on securitisation in a more efficient way, ensuring that the risk weights on securitisation are arbitrage free and that they do not artificially increase the capital requirements on the banking sector as a whole. This proposal is not limited to the SEC-IRBA method: SEC-SA method can easily use the same formulas with limited adjustments (like in the current regulation), and this recalibration should also lead to an update of the tables of Risk Weight used for the SEC-ERBA and IAA methods consistently, in order to reduce arbitrage opportunities. Other steps may be necessary in order to revive the securitisation capital market and promote this method of risk transfer, so that the securitisation becomes a key component of the Capital Markets Union in Europe. This work is also aimed at the Basel Committee, and wishes to contribute to the planned reassessment of the securitisation risk weights, together with other proposals (see Duponcheele (2024)).

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1. We note N(.) the cumulative normal distribution function, and G the inverse function of N(0,1) [↑](#footnote-ref-1)
2. Banks are expected to have around at least 8% CET1 under Basle 3 framework, it was (much) lower than 8% under Basel 2. Because of the various buffers introduced by Basel 3 it is common now to have a higher CET1 level, which means that the deduction is less costly in capital requirement than the Risk Weight treatment. However the calibration of Risk Weights were based on the equivalence with the 8% ratio and we will keep using this ratio for the comparison. [↑](#footnote-ref-2)
3. This small simplification improves computation time while having a limited impact on the result of the optimization. It is also possible to look for a maximum likelihood. [↑](#footnote-ref-3)
4. Like for the standard formula, the RW on securitisation are defined without any EL component. [↑](#footnote-ref-4)
5. The coupon here is not a market-implied coupon. It is calibrated in order to have at the one-year horizon of risk a market value without rating change which is equal to EAD, since in case of default the losses are estimated starting from this value. [↑](#footnote-ref-5)
6. Note that the credit risk in the banking regulation do not take into account the risk on the future revenues, since those revenues are not included in own funds. [↑](#footnote-ref-6)