ASOCIACIÓN ESPAÑOLA DE BANCA

January 31st, 2018

AEB COMMENTS ON EBA'S CONSULTATION ON THE GUIDELINES ON THE MANAGEMENT OF THE INTEREST RATE RISK ARISING FROM NON-TRADING ACTIVITIES

The Spanish Banking Association (from now on, "AEB") thanks the opportunity granted by the EBA to respond to the consultation made last October 31, 2017 on guidelines on the management of interest rate risk arising from non-trading activities (EBA / CP / 2017/19).

Although the AEB has actively worked and participated in the response prepared by the European Banking Federation (EBF), we would like to detail and explain some aspects of the Guideline in our own answer, specially the details concerning question 16: *When aggregating changes to EVE in the supervisory outlier test, Does the disregarding of positive changes to EVE have a material impact on the calculation of the supervisory outlier test?*

Question 1: Are the definitions sufficiently clear? If not, please provide concrete suggestions and justify your answer.

The definition of the Credit Spread Risk in the Banking Book (CSRBB) is too broad *("any kind of spread risk of interest rate sensitive instruments that is not IRRBB or credit risk ")* and does not relate to IRRBB. No only the definition, but also the scope of application is unclear. Consequently, we request to delete the reference to CSRBB from the IRRBB Guidelines.

Furthermore, it would be very useful if the definitions of Core/Transient Balances were detailed in the definitions section. The difference among core and unstable balances is not descripted in the document and a misinterpretation could result in a flawed regulatory report.

Question 3: Do you agree that cash flows from non-performing exposures (NPEs) should be net of provisions and treated as general interest rate sensitive instruments whose modelling should reflect expected cash flows and their timing for the purpose of EV and earnings measures? If not, please provide concrete suggestions and justify your answer**.**

If NPE are treated as interest rate sensitive instruments and consequently included in the economic capital calculation, there can be some potential double counting on the capital calculation with credit risk (for the treatment of LGDs). We recommend to nuance the paragraph 17.g with the same comment that apply to pension obligations: "NPEs should be net of provisions and should reflect the expected cash flow associated to these assets, unless their interest rate risk is captured in another measure".

Additionally, we consider that the NPE's definition is not sufficiently clear in the Guidelines. We would appreciate if it could be confirmed that NPEs refers to the commonly used term NPLs (Non Performing Loans).

Question 4: Are the guidelines in section 4.2. regarding the capital identification, calculation, and allocation sufficiently clear? If not, please provide concrete suggestions and justify your answer.

We agree that IRRBB must be measured from a double approach (EVE and NII perspective), however, regarding the internal capital allocation, additional guidance on the consideration of

earnings would be necessary. A capital charge should only be required when the bank is exposed to a risk of loss, so any capital charge due to a potential reduction of earnings should be excluded from the guidelines. As it is described on the guidelines, its application could generate harmful effects by duplicating the risk of Economic Value and Earnings. It would be necessary to clarify how Income and Economic Value risks should be blended, so that capital allocation appropriately takes into account their combination, avoiding double counting.

Furthermore, in paragraph (29), it is stated that *"Economic Capital may be allocated back to Business Units and Products to ensure that the full costs of the underlying business units or products are properly understood by those responsible for managing them".* Except for certain optionality costs, we consider this request pointless, as there is no IRRBB risk for an individual transaction. IRRBB emerges from the mistmaching between assets and liabilities, and consequently it is centralised in the ALCO where it is managed.

Question 7: Are the guidelines in section 4.4. regarding the measurement sufficiently clear? If not, please provide concrete suggestions and justify your answer.

Paragraph 106c asks to consider potential constraints on the repricing of retail deposits in low or negative interest rate environments (for instance, embedded floors in the customer deposits rate). We agree with this statement, but we belive that it should be extended to considered the assets side embedded options (potential restrictions on the customer loans repricing rates).

Question 8: Do you consider the comparison between EV metrics calculated using contractual terms for NMDs with the EV metrics calculated with behavioural modelled assumptions sensible and practical? Please justify your answer.

The comparison of the EV metrics considering internal models with those resulting from their contractual characteristics does not seem to offer valuable conclusions about the Model Risk of the Institution. Moreover, this comparison could generate misleading results if it is used to make a peers analysis, as it is an inappropriate metric to compare Model Risk among Banks. We would consider more useful to run an analysis about the sensitivity to the assumptions, with comparable shocks to the hypothesis parameters.

Question 12: Which treatment of commercial margins cash flows do you consider conceptually most correct in EV metric, when discounting with risk free rate curve: a) including commercial margins cash flows or b) excluding commercial margins cash flows? Please justify your answer.

We believe that EVE calculation has to be coherent with banks' internal risk frameworks and businesses, which may differ among entities. The decision about the inclusion or not of commercial margins in cash flows and/or discount factors should be anchored in the basis of methodological robustness and comparability.

While some banks prefer the exclusion of commercial margin from the EV metric, when discounting with risk free rate curve, other consider that extracting the commercial margins does not provide an accurate measure and introduces additional adverse effects undermining comparability. As commercial margins need to be estimated, its exclusion introduces subjectivity to the model as a result of the diverse margins estimations and extraction

methods. Besides, it increases complexity to the data collection process and reduces the transparency of the EVE results.

The regulatory enforcement of any alternative should be assessed carefully due to the material additional resources that will have to be devoted. We think that a change of this nature should be discussed deeply before implementation, and final decision should be at least methodologically robust.

Question 13: Are your internal systems flexible enough to exclude margins for the purpose of calculating EV measures for the supervisory outlier test? If not, what would be the cost to adapt your systems (high, medium, low)? Please elaborate your answer.

Not all the institutions' internal systems are flexible enough to exclude margins, as its development depends on the internal management framework.
The adaptation cost will vary among banks, but undoubtedly, the exclusion of commercial margins increases complexity to the data collection process, and it can result very cumbersome and costly, raising doubts about the capacity of less sophisticated banking entities to fulfill supervisor's expectations.

Question 14: Do you consider the level of the proposed linear lower bound as described in paragraph 113 (k) appropriate? If not, please provide concrete suggestions and justify your answer**.**

We find the level of the floor (-150bps) overly conservative. To illustrate this opinion an analysis of the maximum expected movement in base of the historical volatility has been performed. The analysis shows that even for the current very low levels, it is highly improbable for rates to go below -100bps. The analysis has been performed on EUR and GBP, using the 6 month EURIBOR curve for the earlier and 3 LIBOR month curve for the later. Over a 5 year series of returns (computed quarterly and semi-annually) the 1%-ile of the return distribution (representing the most adverse down movements in the curves) was computed. For each tenor of the curve, this extreme down movement was subtracted from the current level of the rate:

$$R_j{}^i(f) = R_j{}^i(t) - R_j{}^i(t-f)$$

$$RF_j{}^i(f) = EB_j^i - percentile_{\%}\left((R_j^i(f)\right)$$

$$floor_{min}^i = \max\left[-\min\left(0; HS_j^i(\min)\right); -\min\left(0; RF_j{}^i(f)\right)\right]$$

$$floor = \max_i\left(floor_{min}^i\right)$$

$\boldsymbol{R_j^i(f)}$: Aditive retunrs $\boldsymbol{EB_j^i}$: Base scenario $\boldsymbol{HS_j^i(\min)}$: Historic minimum $\boldsymbol{(f)}$: Risk factor

The minimum level reached (i.e maximum floor) across all tenors is summarized in the following tables:

EUR FLOOR			
Percentile	*Series length*	*Returns*	
		Quarterly	*Semiannual*
%1: Real return	***2 years***	0,35%	0,33%
	5 years	0,90%	0,99%
%99: abs (return)	***2 years***	0,45%	0,49%
	5 years	0,90%	0,99%

GBP FLOOR			
Percentile	*Series length*	*Returns*	
		Quarterly	*Semiannual*
%1: Real return	***2 years***	0,00%	0,00%
	5 years	0,69%	0,87%
%99: abs (return)	***2 years***	0,00%	0,00%
	5 years	0,69%	0,87%

The previous analysis evidences that a) -1.50% is extremely conservative, and b) a currency dependant floor may be considered.

In addition, over the last years, the use of a multi-curve framework has become an industry sound practice (e.g. OIS, LIBOR 1 month, LIBOR 3 months, LIBOR 6 months and LIBOR 12 months are usually associated to different curves). When considering the same regulatory floor for multiple yield curves in a single currency, the basis spreads between curves might become zero, which reveals a flaw in the proposed methodology. We believe that the current approach does not provide the right incentives to manage the basis risk when the floor takes effect. Hence, we suggest first applying the floor to the risk-free interest rate curve for each currency, and then constructing the rest of the curves for the same currency preserving the current basis spread.

Question 15: Do you consider the minimum threshold for material currencies included into the supervisory outlier test (5% for individual currency and minimum 90% of the total non-trading book assets or liabilities) sufficient to measure IRRBB in term of EVE? If not, please provide concrete suggestions and justify your answer.

We consider that a minimum materiality threshold of 5% for individual currencies and 90% for the total is adequate and aligned with the common practices. However, we deem that an exception should be made in the case that there is an aggregated exposure over 10% which is very fragmented among many currencies with very low materiality (i.e. <2%).

Question 16: When aggregating changes to EVE in the supervisory outlier test, does the disregarding of positive changes to EVE have a material impact on the calculation of the supervisory outlier test?

The magnitude of the impact on the consolidated EVE will strongly depend on the risk profile of each Entity. Indeed, those Banks whose exposure is spread over several currencies, and

hence they are more resilient to a risk event, will be the most affected by the aggregation methodology.

We understand that the objective of the proposed currency risk aggregation methodology for the Outlier Test is to be simple and standardizable in order to maintain comparability among Banks. However, **the methodology proposed is extremely conservative and methodologically wrong,** as it fails to capture the advantages of diversification and it ignores the mitigation effects among different currencies.

The benefits of diversification are well-known and they can be observed on any historical analysis. While correlation among currencies is not perfect (100%), the aggregated losses of a currency diversified portfolio are far beneath the simple aggregation of the worst impacts in each currency (see Appendix 1).

Despite this, the proposal assumes perfect correlation among all currencies, independently of the degree of relationship among them. This is a fatal flaw of the Guidelines as it prejudice Entities with diversified portfolios and discourage Banks to prevent concentration risk.

Moreover, since the methodology does not take into account the correlation among currencies, it does not recognize any compensation effect. This assumption may have a severe impact on Banks operating in markets with multiple currencies promoting unintended consequences on their hedging strategies. Mitigation benefits will depend on the correlation (the higher the correlation, the greater benefit) and the exposure in each currency. Perfect correlations (positive or negative) are difficult to occur, unless IRs are linked by central policy. Likewise, strong negative correlations are uncommon to be observed in real markets. The majority of the currency correlations are positive and the recognition of a mitigation effect is expected.

The **currency risk aggregation methodology** may be determined by different approaches, but any of them **should be based upon historical correlation and the current risk profile of each bank**. In this way, the aggregation methodology should recognize diversification among losses in different currencies and also allow some mitigation benefit between losses and gains for each scenario.

There are alternative methods that, keeping maths simple, solve the main drawbacks of the current EBA GL proposal by taking into account the relationship among currencies and the specific risk exposure of each Bank.

Thus, the aggregation methodology could be divided in the following steps:

1. For each scenario, aggregation of negative impacts (losses) among them, taking into account the diversification across currencies;
2. For each scenario, aggregation of positive impacts (gains) among, taking into account the diversification across currencies;
3. For each scenario, mitigation between the aggregated losses and aggregated gains, taking into account the diversification across currencies;

These steps are described in the following sections (see appendix 2):

1. Aggregated Loss by scenario

The aggregation of currencies with negative impact could be calculated using the following aggregation formula:

$$Aggr.Loss = -\sqrt{\sum_{i} IndivLoss_{CCYi}^{2} + 2 \cdot \sum_{\substack{i,j \\ i<j}} \rho_{i,j} \cdot Indiv\ Loss_{CCYi} \cdot Indiv\ Loss_{CCYj}}$$

Where $Indiv\ Loss_{CCYi}$-, $Indiv\ Loss_{CCYj}$ are the total (negative) impacts of currencies i, j and ρij is the correlation between them. [1]

2. Aggregated Gain by scenario

Similarly, the same aggregation formula could also be applied to currencies with positive impact:

$$Aggr.Gains = +\sqrt{\sum_{i} IndivGains_{CCYi}^{2} + 2 \cdot \sum_{\substack{i,j \\ i<j}} \rho_{i,j} \cdot IndivGains_{CCYi} \cdot IndivGains_{CCYj}}$$

3. Aggregated Impact by scenario

Finally, having calculated the aggregated positive changes and the aggregated negative changes, the final formula would mitigate losses against gains:

$$Aggregated\ \ Sensitivity = Aggr.Losses + C_{Mit.} \cdot Aggr.Gains$$

where ***Cmit*** represents the 'mitigation coefficient' between negative and positive impacts[2].

This is a simple approach that intends to be easy to implement and suitable for standardization, in order to keep comparability among Banks. Consequently, it should be used only for the "Supervisory Outlier Test".

The target of this method is:

- To be simple
- To be suitable for standardization
- To recognize the diversification among impacts on different currencies
- To capture the mitigation effect among impacts on different currencies
- To be sensitive to the correlation among currencies

---

[1] In Appendix 2 could be found a brief explanation of the formula.

[2] In Appendix 2 it is explained why the same formula than in previous steps have been not considered.

- To accommodate to the specific risk profile of each bank

For the purpose of comparability, we suggest the use of regulatory-specified correlations, as they depend on the selected curve instrument, time window and length of historical time series. The complexity of the process could be reduced by identifying clusters of currencies and then prescribing the correlations among them. We recommend, that the mitigation coefficient should also be prescribed by regulators, based on the correlations between currencies with negative and positive changes and the magnitude of their impacts.

In Appendix 3 we propose an alternative approach, that simplifies, even more, the implementation of the proposed aggregation methodology and ease the standardization.

In view of the foregoing, we deem that the EBA GL proposed approach is excessively simplistic and contradicts the spirit of the Guidelines, where a high level of accuracy in measuring IRRBB is expected, especially for the most sophisticated Banks. Although IRRBB by currency may be correctly measured, the final consolidated risk figure will be noticeably inaccurate as impacts are merely added without taking into account correlation effects.

Appendix 1. Diversification and Mitigation historical evidence

Diversification Effect

It is well-known that, while correlation among currencies is not perfect (100%), diversified portfolios show lower risk levels than concentrated portfolios, as a consequence of the diversification effect. This can be observed on any historical analysis.

For example, if we compare two portfolios:
Portfolio 1 is **diversified** in 4 currencies: EUR, USD, MXN and TRY
Portfolio 2 is **concentrated** in 1 currency: EUR

Portfolio 1	EVES (+100pb)	Maximum Hcal Shock (bp)	Maximum Hcal Negative Impact
EUR	1.000	-96	-955
USD	638	-150	-955
MXN	748	-128	-955
TRY	355	-269	-955
			-3.821

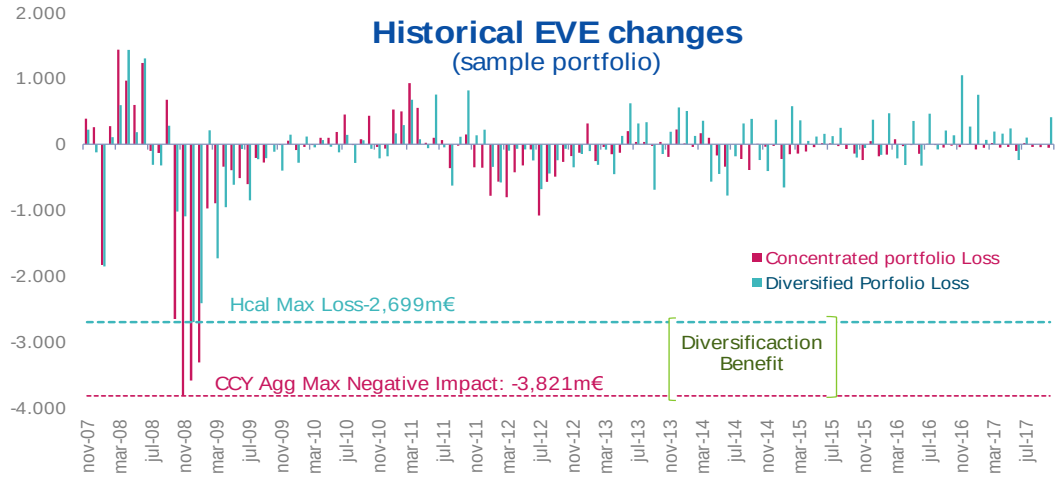
Portfolio 2	EVES (+100pb)	Maximum Hcal Shock (bp)	Maximum Hcal Negative Impact
EUR	4.000	-96	-3.821
			-3.821

For the sake of benchmarking, both portfolios have been designed to have an equivalent currency aggregated maximum negative impact (without diversification effects): 3.821 m€

Even though, the correlation is positive among all the currencies, when we compare the historical behaviour of the Diversified Portfolio, we can observe that the total maximum historical loss of the Portfolio (-2.699m€), it is far beneath its aggregated maximum negative impact (-3.821 m€), as a consequence of the diversification effect (-29%).

Meanwhile, the maximum loss of the concentrated portfolio fits the maximum negative impact, as expected.

The next figure shows the historical impacts of both portfolios. It can be observed, that the **maximum loss of the concentrated portfolio widely exceeds the maximum loss of the diversified portfolio**. This is explained because, as correlation it is less than 100%, the four worst scenarios for EUR, USD, MXN and TRY are much more unlikely to occur at once, than just for one currency.



*For the sample, real Interest Rates historical data has been used

The diversification benefits depend on the correlation between the risk factors (interest rates curves) but also of the composition of the portfolio. The correlation have an impact minimizing the losses in the tail of the distribution even with low correlation between risk factors. In terms of diversification, or a specific level of losses, the decrease in the correlation implied a low probability of occurrence.

For illustrate this, an equally-weighted portfolios (in terms of EVE) has been created. The histogram of the P&L vector has been considered for two distributions; the P&L distribution allowing diversification and the equivalent P&L distribution when diversification is not be considered. The exercise have been implemented over two subporfolios with different level of correlation between currencies. In both cases have been obtained similar conclusions.

The next tables resume the characteristics of the portfolios while the risk factors are those described previously.

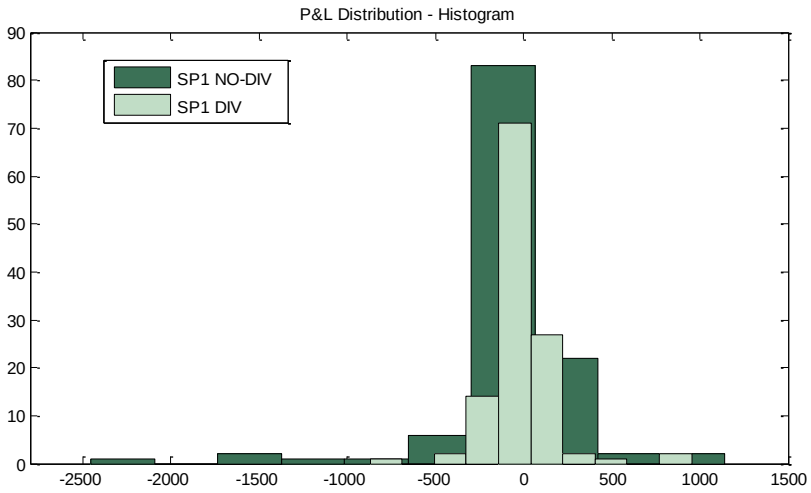
	Sensitivity	EUR	USD	MXN	TRY
Subporfolio1	**EVES**	**1,000**	**1,000**	0	0
Subporfolio2	**EVES**	**0**	**1,000**	**1,000**	0

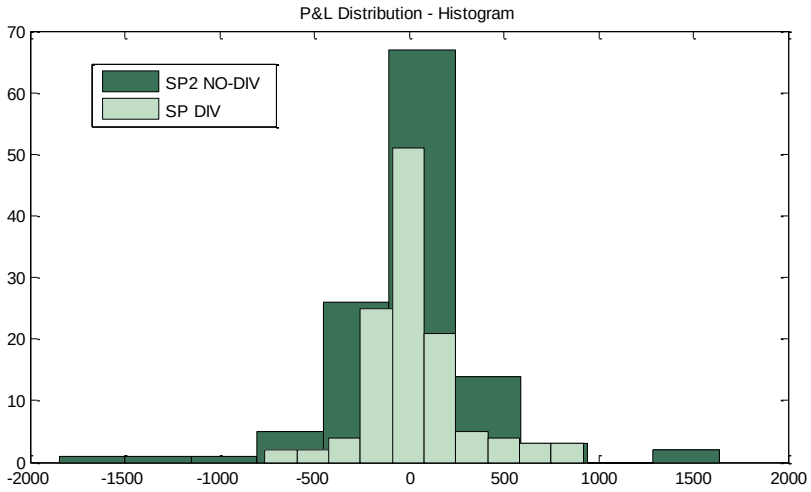
Independently of the level of correlation between the risk factors (except in the rare case of perfect correlation), it exists a diversification benefit when the P&L of the portfolio is considered in contrast to the sum of the individual contributions.

	Correlation (Pearson Coeff.)	*Diversification Benefit*
Subporfolio 1	55%	20%
Subporfolio 2	24%	39%

Next figures show the histogram function of the P&L distributions. In both cases has been compared the P&L distribution allowing diversification with the equivalent P&L distribution if diversification cannot be considered. The equivalent P&L distribution if diversification cannot be considered have been built shorting the P&L data for each vector from smallest to largest

and them summing position to position for each vector. The maximum loss for this vector is the same if the individual losses are aggregated linearly.





In both figures, it can be clearly noted that the distribution for the diversification portfolio have a tiny-tail for loss side of the distribution compared to the equivalent portfolio without diversification.

Mitigation Effect

For aggregation of gain and losses an equivalent result to the diversification effect could be obtained when we compare the aggregated portfolio impacts, with the aggregation of the individual maximum loss of each currency (worst case).

Similarly, we compare two portfolios:
Portfolio 1 is **diversified** in 2 currencies: EUR and USD with opposite sensitivity.
Portfolio 2 is **concentrated** in 1 currency: EUR

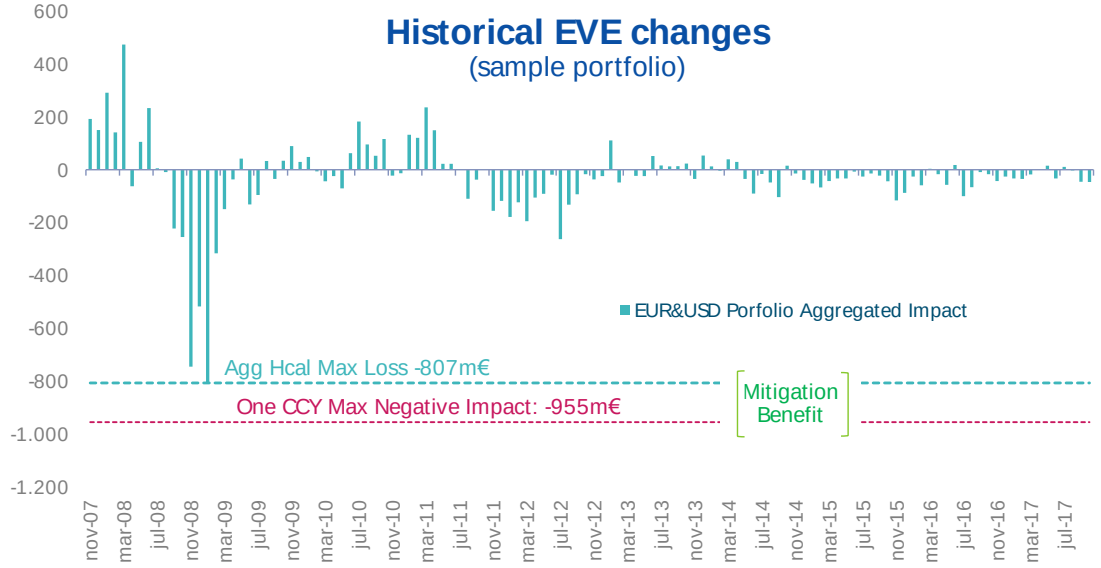
Portfolio 1	EVES (+100pb)	Maximum Hcal Shock (bp)	Maximum Hcal Negative Impact
EUR	1.000	-96	**-955**
USD	-500	-150	749

Portfolio 2	EVES (+100pb)	Maximum Hcal Shock (bp)	Maximum Hcal Negative Impact
EUR	1.000	-96	**-955**

Once again, if we compare the historical behaviour of the Diversified Portfolio, we can observe that the total maximum historical loss of the Portfolio (-807m€), it is lower than the individual maximum negative impact on one single currency EUR (-955 m€). This is a consequence of the mitigation effect of the exposure in USD (-16%).

The next figure shows the historical impacts of EUR&USD aggregated portfolio, against the maximum negative impact in one currency (EUR).

It can be observed, that the **maximum loss of the aggregated portfolio is lower than the maximum negative impact in one currency**. This is explained because, as correlation is positive, when the EUR balance suffers a loss it is likely that the USD balance obtains a gain.



*For the sample, real Interest Rates historical data has been used

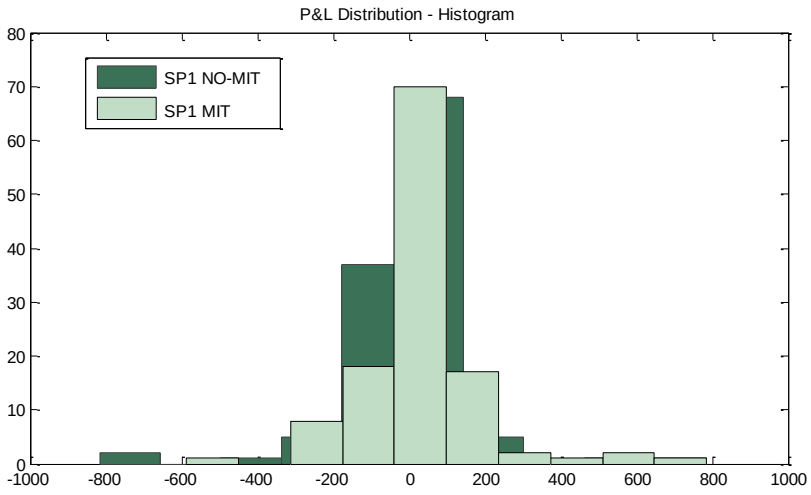
Likewise, as in the case of diversification, the mitigation benefits depend on the correlation among the risk factors (interest rates curves) and also on the composition of the portfolio. To illustrate this case two subportfolios have been considered, in this case with opposite impacts.

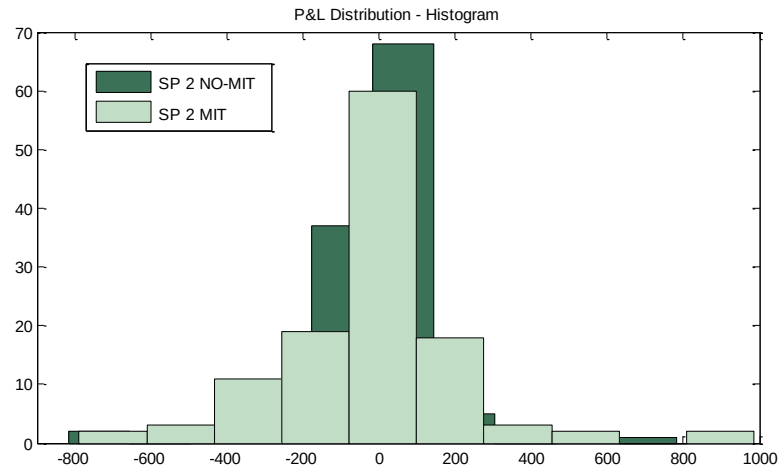
	Sensitivity	EUR	USD	MXN	TRY
Subporfolio1	**EVES**	**-1,000**	**1,000**	0	0
Subporfolio2	**EVES**	**0**	**1,000**	**-1,000**	0

Independently of the level of correlation among the risk factors, it exists a mitigation benefit when the P&L of the portfolio is considered in contrast to the worst-case (Negative impact).

	Correlation (Pearson Coeff.)	*Mitigation Benefit*
Subporfolio 1	55%	31%
Subporfolio 2	24%	14%

Next figures show the histogram function of the P&L distributions. In both examples, it has been compared the P&L distribution allowing mitigation with the Worst-Case Distribution (one currency).





In both figures can be note that the distribution for the diversification portfolio have a tiny-tail for loss side of the distribution compared to the equivalent portfolio without mitigation. Even in the case of low correlation, although the difference in tail distribution is less marked.

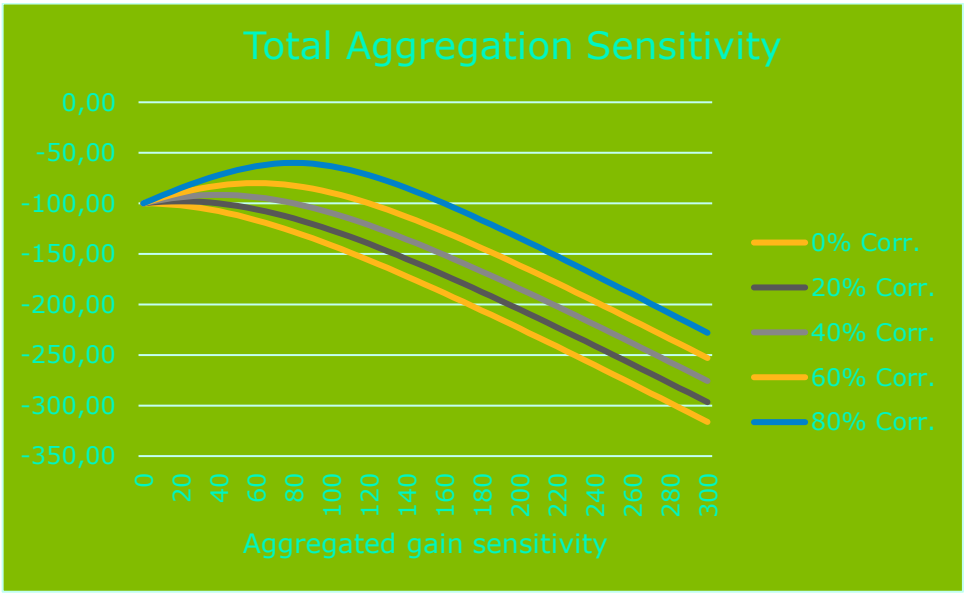
Appendix 2. Aggregation Methodology

The proposed formula for aggregation of losses or gains in steps 1 and 2 are based on the usual formula considered for calculating the variance of a sum of random variables.
If X and Y are two random variables

$$Var(X+Y) = Var(X) + Var(Y) + 2COV(X,Y)$$

Regardless the distribution considered, this formula has frequently been used in the industry to aggregate losses, e.g. through a parametric VaR, or to aggregate sensitivities, see for example delta aggregation under the Fundamental Review of the Trading Book (Standardardized Approach).

This formula has been proposed only for aggregation within losses and gains and not in the third step to aggregate between gain and losses because in this case the methodology is not appropriate. The formula incorporate the impact of the metrics but cannot recognize the sign of the impacts. This can lead to unexpected behavior of the aggregated metric.
The next figure shows the aggregation effect when a portfolio with aggregated losses equal to -100 is considered and different values for the aggregated gains are taking into account. When the gains are increasing, although for some levels of correlations initially the total aggregation impact decrease moving towards positive impacts (especially for high correlations), right back into an increase of the negative impact, this negative aggregate impact is maintained even for high correlations when the gains exceed the losses for two of three times.



For this reason, for the mitigation between losses and gains we suggest the use of a simplified formula where the losses are mitigated by the gains multiplied by a coefficient. This coefficient could be an average of the correlation effect or could be defined for different clusters of correlation and the magnitude of the changes.

Appendix 3. Aggregation Methodology Simplification

1. Introduction

The proposed aggregation methodology could be simplified to reduce the complexity in the implementation and promote standardization.
Although it is slightly less accurate, this approach still takes into account the relationship among currencies and the specific risk exposure of each Bank, in order to properly capture the diversification and mitigation effects when aggregating risks. But in exchange, it is easier to implement and even more suitable for standardization.

2. Aggregation Methodology

To get a consolidated impact for each scenario, we aggregate to the negative impact in the main currency , the marginal contribution of each additional currency:

$$Aggregated\ Impact_{scen} = Individual\ Loss_{Main\ CCY} + \sum_{i \neq MainCCY} Marginal\ Loss_{CCYi} + \sum_{j} Marginal\ Gain_{CCYj}$$

Thus, for each scenario:

1. First, we select the "Main Currency", which is the currency with the biggest negative impact for that scenario.
2. Secondly, we will aggregate the Marginal Loss of any additional currency with a negative impact, to the individual loss in the main currency

$$Aggregated\ Loss_{Diversif} = Individual\ Loss_{Main\ CCY} + \sum_{i \neq MainCCY} Marginal\ Loss_{CCYi}$$

   - For each currency, the Marginal Loss will be a percentage of its Individual Loss.

$$Marginal\ Loss_{CCYi} = Aggregation\ Coefficient_{CCYi} \cdot Individual\ Loss_{CCYi}$$

This is,

$$AggregatedLoss = Individual\ Loss_{Main\ CCY} + \sum_{i \neq MainCCY} Aggregation\ Coefficient_{CCYi} \cdot Individual\ Loss_{CCYi}$$

The Aggregation Coefficient for each currency (i) will be based on 2 factors:

- ✓ *Correlation between the Main Currency shock and the shock of the additional currency (i).*
- ✓ *The size of the Individual Loss of the additional currency (i), with respect to the size of the Main Currency Loss*.

3. Finally, we will aggregate the Marginal Gain of any additional currency with a positive impact, to the Aggregated Loss.

$$Aggregated\ Impact_{scn} = Individual\ Loss_{Main\ CCY} + \sum_{i \neq MainCCY} Marginal\ Loss_{CCYi} + \sum_{j} Marginal\ Gain_{CCYj}$$

- Similarly, for each currency, the Marginal Gain can be expressed as a percentage of its Individual Gain:

$$Marginal\ Gain_{CCYj} = Mitigation\ Coefficient_{CCYj} \cdot\ Individual\ Gain_{CCYj}$$

So,

$$\begin{aligned} Aggregated\ Impact_{scen} &= Individual\ Loss_{Main\ CCY} \\ &+ \sum_{i \neq MainCCY} Aggregation\ Coefficient_{CCYi} \cdot Individual\ Loss_{CCYi} \\ &+ \sum_{j} Mitigation\ Coefficient_{CCYj} \cdot\ Individual\ Gain_{CCYj} \end{aligned}$$

In summary, it is a very simple approach that can be easily standardized for which it would be enough to prescribe the coefficients matrix. Indeed, for the sake of comparability and prudence, **we would recommend that coefficients matrix is provided by the Supervisors**.

3. Coefficients Calibration

The aggregation/mitigation coefficients can be calibrated using different methods, or they could be directly prescribed by Supervisors. Nevertheless, it is important that their value depends on the correlations among currencies, and preferably they should vary with the size of the impacts.

▪ Aggregation Coefficients

An appropriate way to estimate the coefficients may be isolating them by using the two following equivalent expressions:

$$Aggregated\ Loss_{Main\&i} = \sqrt{Indiv\ Loss^2_{Main\ CCY} + IndivLoss^2_{CCYi} + 2 \cdot \rho_{Main,i} \cdot Indiv\ Loss_{MainCCY} \cdot Indiv\ Loss_{CCYi}}$$

$$Aggregated\ Loss_{Main\&i} = Individual\ Loss_{Main\ CCY} + Aggregation\ Coefficient_{CCYi} \cdot Individual\ Loss_{CCYi}$$

Where, $\rho_{Main,i} = correlation\ between\ Main\ Currency\ and\ Currency\ i$

Now, if we express the Individual Loss for the currency (i) as a percentage of the Main Currency Loss ($Indiv\ Loss_{CCYi} = w_i \cdot Indiv\ Loss_{Main\ CCY}$), we can get to the following final expression:

$$Aggregation\ Coefficient_i = \frac{Aggregated\ Loss_{Main\&i} - Indiv\ Loss_{MainCCY}}{Indiv\ Loss_{CCYi}}$$

$$= \frac{\sqrt{Indiv\ Loss^2_{Main\ CCY} + Impacto_i^2 + 2 \cdot \rho_{Main,i} \cdot Indiv\ Loss_{MainCCY} \cdot Indiv\ Loss_{CCYi}} - Indiv\ Loss_{MainCCY}}{Impacto_i}$$

$$= \frac{\sqrt{Indiv\ Loss^2_{Main\ CCY} + (w_i \cdot Impacto_{Base})^2 + 2 \cdot \rho_{Main,i} \cdot Indiv\ Loss_{MainCCY} \cdot (w_i \cdot Impacto_{Base})} - Indiv\ Loss_{MainCCY}}{(w_i \cdot Indiv\ Loss_{MainCCY})}$$

$$= \frac{\sqrt{1 + {w_i}^2 + 2 \cdot \rho_{Main,i} \cdot w_i} - 1}{w_i}$$

Where, $W_i = \frac{Indiv\ Loss_{CCYi}}{Indiv\ Loss_{MainCCY}}$

This method could also be used to isolate the mitigation coefficients, although the resulting values should be adjusted to avoid inconsistent results.

- ## Coefficients Matrix

The resulting Coefficients Matrix could be simplified as much as desired, in order to reduce the estimated values, and/or it could be prescribed by regulator to strengthen the comparability of the outlier test. Additionally, if it would be wanted to introduce a higher degree of conservatism, correlations could be stressed resulting in more conservative coefficients. The following table shows an example of possible coefficient ranges that could be defined.

Example COEFFICIENTS MATRIX (To be prescribed by Regulators)

AGGREGATION COEFFICIENTS		ω (weight)		
		HIGH	MEDIUM	LOW
CORRELATION	PERFECT NEGATIVE	%	%	%
	STRONG NEGATIVE	%	%	%
	MEDIUM NEGATIVE	%	%	%
	LOW NEGATIVE	%	%	%
	WEAK	%	%	%
	LOW POSITIVE	%	%	%
	MEDIUM POSITIVE	%	%	%
	STRONG POSITIVE	%	%	%
	PERFECT POSITIVE	%	%	%