EBA/GL/2016/09

11/10/2016

Final Report

Guidelines on corrections to modified duration for debt instruments under Article 340(3) of Regulation (EU) 575/2013

Contents

1. Executive Summary

Regulation (EU) No 575/2013 (CRR) establishes two standardised methods to compute capital requirements for general interest rate risk. Article 339 establishes the so-called Maturity-Based calculation for general interest risk, while Article 340 regulates the Duration-Based calculation of general risk.

The Duration-Based method applies the concept of Modified Duration (MD), defined according to the formulas in Article 340(3) of the CRR. This formula is valid only for instruments not subject to prepayment risk. Accordingly, a correction to the duration becomes necessary to reflect this risk. In this regard, Article 340(3) of the CRR establishes the mandate for the EBA to issue guidelines establishing how the 'correction shall be made to the calculation of the modified duration for debt instruments which are subject to prepayment risk.'

Two approaches are proposed in these draft Guidelines to correct the MD calculation:

i. Treat the debt instrument with prepayment risk as if it was really a combination of a plain vanilla bond and an embedded option. Correct the Modified Duration of the plain vanilla bond with the change in value of the embedded option, estimated according to its theoretical delta, resulting from a 100 basis points (b.p.) movement in interest rates.

ii. Alternatively, calculate directly the change in value of the whole instrument subject to prepayment risk resulting from a 100 b.p. movement in interest rates.

Additionally, the guidelines request to compute the following elements to the correction:

i. Under the first approach, the theoretical delta of the embedded option will either overestimate or underestimate the correction that should be applied to the MD. To avoid this, the positive or negative effect of the convexity stemming from the embedded option should be computed. Under the second approach it is not necessary to correct convexity, since its effect would already be included in the repricing of the instrument.

ii. Under both approaches it is requested that the effect of transaction costs and behavioural factors are also reflected (where these are sufficiently relevant) in the correction. The guidelines request the consideration of these factors to reflect the fact that some of the options' buyers, in particular retail clients, might decide not to execute the option despite being in the money.

2. Background and rationale

The CRR establishes two standardised methods to compute capital requirements for general interest rate risk. Article 339 establishes the so-called Maturity-Based calculation for general interest risk, while Article 340 regulates the Duration-Based calculation of general risk.

Duration (D) and Modified Duration (MD) are well known concepts used in finance to measure the sensitivity (percentage change) in price for a unit change (parallel movements) in its Internal Rate of Return (IRR) of any financial asset that consists of fixed cash flows. According to the formula stated in Article 340(3) of the CRR Duration (D) is:

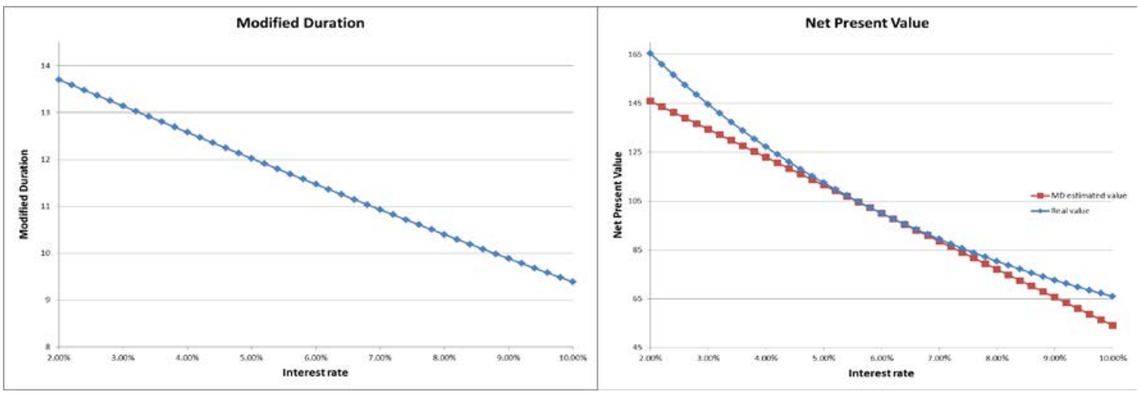
$$D = \frac{\sum_{t=1}^{M} \frac{t \cdot C_t}{(1+R)^t}}{\sum_{t=1}^{M} \frac{C_t}{(1+R)^t}}$$

where R is yield to maturity, C_t is cash payment in time t and M equals the total maturity

The modified duration (MD) is an adjusted version of the duration, which accounts for changing yield to maturities. The formula for the modified duration is the value of the duration divided by 1 plus the yield to maturity:

$$MD = \frac{D}{1+R}$$

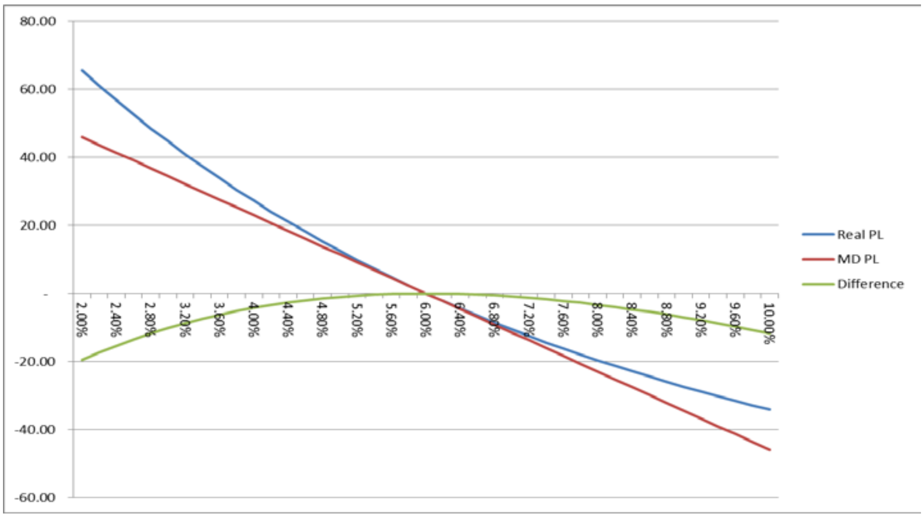
Behind both concepts there is the fact that the price of a financial asset that consists of fixed cash flows is inversely related to interest rate. The relationship (curved) price-yield can be represented with a linear approximation, the duration. This linear approximation may be observed in Graph 1 (a) below, where the modified duration and the net present value of a bond as a result of movements in yield of a 20 year bond with a 6% coupon are represented:



Graphs 1(a) Modified Duration and 1(b) Net Present Value, real and estimated with the Modified Duration

As may be observed in Graph 1(b), the actual relationship between the IRR and the value of a bond is non-linear, while the relationship between the IRR and the MD is linear. Therefore, the modified duration can be represented as the first derivative (or 'delta') of the value of the bond, divided by the current price of the bond. The price-yield curve is a convex function (i.e. has positive gamma) for long positions (i.e. where cash flows are received from the issuer) and a 'concave' function (i.e. has negative gamma) for short positions.

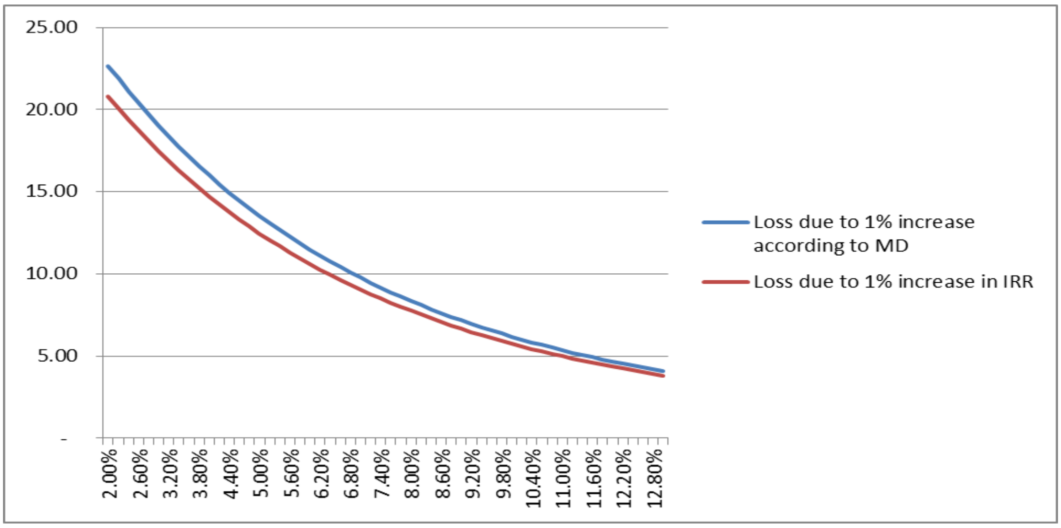
As a result, for long directional positions, applying the modified duration would provide a conservative estimation of the real loss that a bank would experience in case of an increase in interest rates. Just like with convex options with positive gamma, the delta overestimates potential losses in case of an increase in interest rates and underestimating potential gains in case of a decrease; this may be observed in Graph 2, where the real and MD-estimated profit and loss (PL), observed for increases and decreases in IRR starting from the 6% level, for the same bond described above are shown:



Graph 2: Real PL vs MD-estimated PL

At the same time it also clear, just like with delta profit and loss approximations used for options, that the delta estimation of change in value (the MD in our example) is more accurate for small changes (i.e. when we are close to the current price of the bond) and is less precise when we try to assess large movements.

Nevertheless, the change in IRR would also affect the MD calculation, just like a movement in the underlying of an option affects its delta. Accordingly, if the MD is recalculated after every movement in IRR, we will observe a closer relationship between the 'real' and the 'estimated' profit and loss. This can be seen in Graph 3, which represent 'real' and 'estimated' losses on the price of the bond used previously in case of an increase of 1% in IRR. It may also be observed that the loss based on the MD is consistently higher than the real one.



Graph 3: Real vs MD-estimated losses

Of course if we used the MD to estimate losses for short positions the situation would be the reverse one, so the real loss resulting from a decrease in IRR would be consistently higher than the one estimated based on the MD.

Duration-based metrics would be generally conservative for directionally-long portfolios, while they might underestimate potential losses for directionally-short portfolios. Regardless of this, the Standardised Approach does not include any adjustment to correct convexity; however, the convexity stemming from any embedded optionality should be considered in these guidelines when calculating any correction to the modified duration.

2.1 EBA mandate

The concept of Modified Duration, as exposed in the introduction and defined according to the formulas in Article 340(3) of the CRR, is valid only for instruments not subject to prepayment risk. Accordingly, a correction to the duration becomes necessary to reflect this risk.

In this regard, Article 340(3) of the CRR includes the mandate for the EBA to issue guidelines establishing how the 'correction shall be made to the calculation of the modified duration for debt instruments which are subject to prepayment risk.'

The mandate relates to the incorporation of 'prepayment risk'; accordingly, it could be argued that the institution has to reflect only the effect of sold embedded optionality. In other words, it would only have to introduce a correction if the counterparty has the possibility of paying a bond early (for long positions) or asking for an early refund of debt issued by the institution (for short positions).

However, bought options also introduce 'prepayment risk', to the extent they are subject to P&L losses. Accordingly these guidelines also cover the situation in which the institution has the right to request an early prepayment (i.e. puttable bonds bought or callable bonds issued).

2.2 Effect in capital of the correction to reflect prepayment risk

It should be noted that the effect of any correction to the modified duration to reflect 'prepayment risk' will always be negative, i.e. the duration of a bond with embedded optionality will always be lower than (or, at a minimum for deep out of the money options, equal to) the one obtained for the plain vanilla bond. Regardless of its sign, the same thing could be said for a short position where the counterparty has the option to call for an early payment (e.g. a put bond, puttable bond or retractable bond).

Of course, since capital requirements under the standardised approach are higher for bonds with a longer maturity, the incorporation of the 'prepayment risk' would have the apparently paradoxical effect of reducing the capital requirement for the bond with embedded optionality, when compared to the same position without considering the optionality.

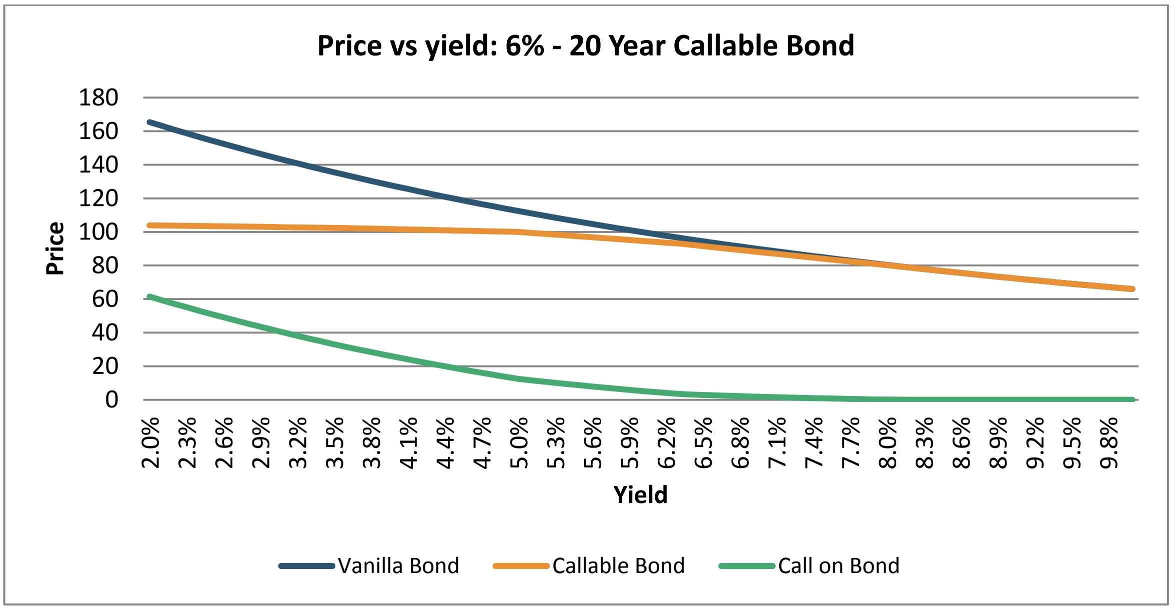
This result may seem counterintuitive; however it accurately reflects the real sensitivity stemming from a financial asset that consists of fixed cash flows with embedded optionality. Indeed, if for example we look at a callable bond whose embedded optionality is deep in the money, the Corrected Modified Duration (CMD thereafter) will be significantly lower than the MD we would observe without the optionality.

This reflects the fact that the real maturity of the bond would almost certainly be the first date on which the bond can be called; in addition, any increase in interest rate would have a negligible effect on the value of the bond due to the effect of the sold option. Both features (short time to effective maturity and nearly zero sensitivity to changes in interest rates) fully justify a lower capital requirement[1].

Conversely, if we consider now a callable bond whose embedded optionality is deep out of the money we will observe that both the value of the option and the corresponding 'correction' of the modified duration are close to zero. In this case, the behaviour of the callable bond is nearly the same as the one that would be observed for the plain vanilla bond alone; accordingly, the CMD becomes almost the same as the MD, the effect of changes in IRR would affect both bonds in a similar way and the capital requirement would also be the same.

Both effects can be observed in Graph 4 below, where the relationship price-yield of a 20 year callable bond is shown (see technical annex for further elaboration):

[1] Of course, the valuation of the embedded option sold shall be reflected (deducted) in the value of the callable bond.



Graph 4: Price-yield relationship for a plain vanilla bond, a callable bond and the call option embedded

As can be seen in Graph 4 above, an increase in IRR (e.g. moves up from 6% to 8%) causes a decrease in the price of both the vanilla bond and the callable bond. It is notable how the prices of the two bonds tend to converge when the IRR increases; of course this is due to the fact that the embedded option goes out of the money and its value gets close to zero. However, when the IRR decreases (e.g. moves from 6% down to 4%) the call option moves 'in the money' (ITM) and the price of the two bonds diverge; the vanilla bond price increases significantly while the callable bond tends to be capped at 100. In this second case, the value of the sold option, now ITM, will be deducted from the positive value of the vanilla bond[2], making the value of the callable bond almost insensitive to movements in interest rates.

2.3 Main features of the embedded optionality

Any instruments subject to prepayment risk, typically debts securities, differ from vanilla instruments because the maturity of the product is no longer fixed, but becomes variable.

This uncertainty in the maturity of the product is introduced by the embedded optionality, which gives the right to extinguish in advance the underlying obligation.

The complexity of the embedded prepayment optionality varies, however it generally has the following features:

- Its value will be a factor of the shape of the yield curve and its dynamics, which represent the optionality nature of the callable/puttable feature.

[2] Having a long position in a callable bond is equal to having a long position in a Vanilla Bond plus a short position in a call option on the same bond.

- It usually has multiple exercise dates, which are represented by a Bermudan feature.
- Normally, the premium for the embedded optionality sold by the investor is incorporated in the bond by way of a higher coupon, relative to comparable non-callable transaction, and/or lower value.
- The optionality embedded in the instrument biases or reverses the classical convex relationship between price and yield of long bond positions; the same effect can be observed for the negative convexity stemming from short positions.

2.4 Convexity effect introduced by the embedded optionality

The data included in Table 1[3] below show that, for a long position in a callable bond, the losses estimated using the CMD are smaller than the ones really produced by a shift in the IRR, while the gains estimated according to the CMD are higher than the real ones. This is the opposite of what happens with the MD, as may be observed in Graph 2.

Table 1. In The Money Callable Bond

Interest rate	Shock BP	Price Vanilla Bond	Estimated P&L with MD	Actual P&L	Bond with Embedded Option	Estimated P&L with CMD	Actual P&L
6.00%	100	100.00	- 13.59	- 12.46	94.70	- 3.47	- 5.29
5.80%	80	102.33	- 10.87	- 10.13	95.78	- 2.77	- 4.21
5.50%	50	105.98	- 6.80	- 6.49	97.34	- 1.73	- 2.65
5.20%	20	109.80	- 2.72	- 2.66	98.92	- 0.69	- 1.06
5.00%	-	112.46	-	-	99.98	-	-
4.80%	- 20	115.21	2.72	2.75	100.33	0.69	0.34
4.50%	- 50	119.51	6.80	7.05	100.81	1.73	0.83
4.20%	- 80	124.04	10.87	11.57	101.30	2.77	1.31
4.00%	- 100	127.18	13.59	14.72	101.63	3.47	1.65
Duration			12.08			3.47	

Table 1: CMD P&L approximation for a plain vanilla bond and a callable bond using only first order approximations

In this regard, the positive convexity stemming from the plain vanilla bond is fully compensated by the negative convexity that the embedded sold optionality (equivalent to a payer swaption) produces. Accordingly, for long positions in callable bonds, loss assumptions based on CMD would underestimate the real losses produced[4].

For callable bonds issued by the institution (i.e. short positions where the bank has the right to call for an early termination) the MD would generally underestimate the loss, so the positive

[3] Theoretical example for a 20-year bond, 6% coupon, with a 10 years embedded American call option. The strike price of the call is 100, and the exercise dates of the option start after the first year. The data come from the same theoretical example reported in the technical annex, therefore the bond and the option are valued using the Hull-White model.

[4] If the long position is in a puttable bond, both the plain vanilla bond and the embedded option bought would have positive convexity, making the CMD conservative.

gamma[5] (positive convexity) of the bought optionality (equivalent to a receiver swaption in this case) would compensate the underestimation of the loss produced by the MD of the short position.

For long positions in puttable bonds (i.e. long positions where the bank has the right to call for an early termination), both the bond and the embedded optionality would show positive gamma while for puttable bonds issued by the bank, both the short interest rate position and the embedded optionality would show negative convexity.

The regulation[6] for options under the delta-plus approach establishes that the convexity ('gamma impact') shall only be incorporated into the capital calculation when it is addressing a loss underestimation produced by the first-order estimation (delta), in this case the delta overestimates the potential gain due to the movement in the underlying, though from a capital perspective we are just concerned about loss underestimation. Accordingly, only negative gamma is included in the calculation of capital under standardized rules while positive gamma is ignored.

The consultation paper consulted on the possibility of correcting the gamma only when it was negative (ignoring it when the outcome was greater than zero); however, following the feedback received, the final draft guidelines require the convexity to be corrected in both cases (i.e. either with positive or negative gamma) to avoid the situation where broken hedges might produce an unjustified capital requirement (potentially disincentivizing proper risk management practices) as well as to improve in all cases the accuracy of the corrected modified duration metric obtained.

2.5 Proposed Correction to Modified Duration

It is the embedded optionality that makes the future cash flow payment variable, and makes the Modified Duration formula no longer reliable to approximate the change in value of the instrument due to a change in interest rate.

It is common to treat this kind of 'hybrid instruments' by segregating them into two tractable components: the vanilla bond instrument and the interest rate option. Of course, the 'option' in this case is not a standalone independent instrument; indeed the embedded optionality is the feature of the bond that turns it into a 'hybrid instrument[7]' and which should be considered when correcting the MD.

It should be noted that this treatment is more straightforward for simple callable/puttable bond, while for mortgage backed obligation this relationship could be more complex.

[5] It may be argued that for short plain vanilla positions (i.e. with no embedded optionality) the MD should be corrected with the negative gamma in order to avoid underestimating the potential loss of the positions; however, the treatment for MD is clearly stated in Article 340 of the CRR. In addition the MD calculation is outside the scope of these guidelines.

[6] See the EBA's RTS on non-delta risks http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:JOL_2014_148_R_0007

[7] According to IAS 32 and IAS 39 a financial instrument containing an embedded derivative is referred to as a 'hybrid financial instrument'.

The guidelines use the following formula for the CMD:

- Since the value of the instrument is equal to the value of the vanilla bond instrument, plus or minus (depending on whether the institution has bought or sold the option) the value of the embedded option, the CMD is approximated as the difference of the Modified Duration of the vanilla instrument and the first order approximation of the change in value of the option due to the change in the underlying value (i.e. equivalent to the delta) of the option embedded, adjusted by the current price of the bond.

- As previously mentioned the negative or positive gamma introduced by the embedded optionality should be factored, adjusted by the price of the bond and the change in value of the interest rate and divided by two (i.e. in consistency with Taylor series approximation).

- Apart from the previous adjustments, the guidelines request that an additional correction factor is considered in order to reflect any significant transaction costs that the early payment of the callable bond might produce, as well as behavioural factors, which would reflect the fact that some of the options' buyers might decide not to execute the option despite being in the money. This additional correction shall be either considered in the delta / gamma calculations or, alternatively, treated as a separate factor.

$$CMD = MD \times \Phi \times \Omega$$

where[8]:

$MD = Modified\ Duration\ as\ in\ Art.\ 340(3)$

$\Phi = \frac{B}{P}$

$\Omega = 1 + \Delta + \frac{1}{2}\Gamma\, dB + \Psi$

$\mathrm{P} = Price\ of\ the\ bond\ with\ the\ embedded\ optionality$

$\mathrm{B} = Theoretical\ price\ of\ the\ Vanilla\ Bond$[9]

$\Delta = Delta\ of\ the\ embedded\ option$

$\Gamma = Gamma\ of\ the\ embedded\ option$

$\Psi = Additional\ factor\ (consistent\ with\ a\ general\ IRR\ movement\ of\ 100\ b.p.)$[10]

$dB = Change\ in\ value\ of\ the\ underling$

[8] An illustration of how the formula is derived is shown in the technical annex of these guidelines.

[9] The price of the vanilla bond should be a theoretical price compatible with the institution valuation model.

[10] The value of this additional factor shall be zero if it has already been considered in the delta/gamma calculations.

The additional factor, consisting of transaction costs and 'behavioural' factors, is introduced to ensure that the corrected modified duration reflects conservatively the maturity of the callable bond, so it should never lead to a shorter CMD than if it was not considered in the calculation.

Transaction costs will reduce the value of the option, making it unlikely to be executed below the threshold established by the transaction costs.

Finally, 'behavioural' factors shall be introduced to reflect the fact that some clients, in particular retail ones, may not always exercise the option, even when it is in the money. These behavioural factors should only be considered where they are significant. In this regard, it is understood that for a majority of banks very few, if any, of the hybrid instruments booked in the trading book will be held by retail clients; however, in some jurisdictions, retail clients do hold these kinds of hybrid positions. Where relevant, these behavioural factors may be explained by some known elements, such as:

- Size of the principal outstanding compared with initial lending: when the remaining principal is close to the initial amount lent, borrowers tend to react faster to gains from prepayment. These 'aggressive' borrowers tend to leave (or refinance) at an early stage. Conversely, as time goes by, the remaining borrowers tend to be the most 'rigid' ones and are not likely to execute the embedded option.

- Principal size: the group of borrowers that has the largest loan size is the group likely to have the largest prepayment rate, as these borrowers have the largest gain from prepayment as the cost attached to prepayment is a fixed amount.

Institutions shall assess these factors and incorporate them into their calculations of the CMD based on historical data, obtained from their own experience or from external sources. Data on the behavioural factors may be obtained from the assessment of other balance sheet elements subject to prepayment risk, such as those observed for retail clients in the non-Trading Book.

The additional correction should be determined by assessing any significant divergence between the real behaviour historically observed for a type of client (such as retail) and the theoretical behaviour that would have been envisaged for counterparties acting in a purely rational way. These adjustments due to behavioural factors shall not be considered for those embedded options where the institution has the right to call for an early termination of the instrument (such as puttable bonds bought by the firm).

The consideration of these behavioural elements for certain kind of clients is a departure from the Market Risk framework in general, where the assumption is that any agent in the market will act in a fully rational way, so any opportunity costs will be avoided. However, as explained previously, the effect of introducing these factors allows the alignment of the duration of the instruments with the one historically observed, which would be generally longer and, thus, subject to higher capital requirements.

Alternatively, institutions may re-compute directly the CMD by repricing the instrument after shifting the IRR by 100 b.p. In this case, no gamma correction is necessary, since the instrument is fully revalued and no delta approximation is applied. In addition, firms may also directly include the additional correction described previously in the pricing of the instrument, or treat it otherwise as a separate additional factor.

Under this second alternative, the following methodology should be applied to the CMD:

$$CMD = \frac{\mathrm{P}_{-\Delta r} - \mathrm{P}_{+\Delta r}}{2 \times \mathrm{P}_0 \times \Delta r} + \Psi$$

Where:

$\mathrm{P}_0 = The\ current\ market\ price\ of\ the\ product;$

$\mathrm{P}_{\mp\Delta r} = theoretical\ price\ of\ the\ product\ after\ a\ negative\ and\ a\ positive\ interest\ rate\ shock\ equals\ to\ \Delta r;$

$\Delta r = hypotetical\ intrest\ rate\ change\ of\ 50\ b.p.$

$\Psi = \ transaction\ costs\ and\ behavioural\ variables\ consistent\ with\ a\ general\ IRR\ movement\ of\ 100\ b.p.$[11]

[11] The value of this additional factor shall be zero if it has already been considered in the theoretical price of the product after negative and positive interest rate shock calculations.

3. Draft guidelines

EBA/GL/2016/09

11/10/2016

Guidelines

on corrections to modified duration for debt instruments under the second subparagraph of Article 340(3) of Regulation (EU) 575/2013

1. Compliance and reporting obligations

Status of these guidelines

1. This document contains guidelines issued pursuant to Article 16 of Regulation (EU) No 1093/2010[12]. In accordance with Article 16(3) of Regulation (EU) No 1093/2010, competent authorities and financial institutions must make every effort to comply with the guidelines.

2. Guidelines set the EBA view of appropriate supervisory practices within the European System of Financial Supervision or of how Union law should be applied in a particular area. Competent authorities, as defined in Article 4(2) of Regulation (EU) No 1093/2010, to whom guidelines apply, should comply by incorporating them into their practices as appropriate (e.g. by amending their legal framework or their supervisory processes), including where guidelines are directed primarily at institutions.

Reporting requirements

3. According to Article 16(3) of Regulation (EU) No 1093/2010, competent authorities must notify the EBA as to whether they comply or intend to comply with these guidelines, or otherwise with reasons for non-compliance, by ([dd.mm.yyyy]). In the absence of any notification by this deadline, competent authorities will be considered by the EBA to be non-compliant. Notifications should be sent by submitting the form available on the EBA website to compliance@eba.europa.eu with the reference 'EBA/GL/201x/xx'. Notifications should be submitted by persons with appropriate authority to report compliance on behalf of their competent authorities. Any change in the status of compliance must also be reported to EBA.

4. Notifications will be published on the EBA website, in line with Article 16(3).

[12] Regulation (EU) No 1093/2010 of the European Parliament and of the Council of 24 November 2010 establishing a European Supervisory Authority (European Banking Authority), amending Decision No 716/2009/EC and repealing Commission Decision 2009/78/EC, (OJ L 331, 15.12.2010, p.12).

2. Subject matter, scope and definitions

Subject matter

5. These guidelines specify how to apply corrections to the calculation of the modified duration to reflect prepayment risk, in accordance with the mandate conferred to the EBA in the last subparagraph of Article 340(3) of Regulation (EU) No575/2013[13].

Scope of application

6. These guidelines apply in relation to the calculation of the modified duration for debt instruments which are subject to prepayment risk for the purposes of own funds requirements for General Interest Rate Risk under the standardized approach in accordance with Article 340 of Regulation (EU) No 575/2013.

Addressees

7. These Guidelines are addressed to competent authorities as defined in point (i) of Article 4(2) of Regulation (EU) No 1093/2010 and to financial institutions as defined in Article 4(1) of Regulation No 1093/2010.

Definitions

8. Unless otherwise specified, terms used and defined in Regulation (EU) No 575/2013 and Directive (EU) 36/2013 have the same meaning in the guidelines.

9. For the purpose of these guidelines, the following definitions apply:

   (a) a callable bond is a type of debt instrument that gives the issuer of the bond the right, but not the obligation, to redeem the bond at some point before it reaches its date of maturity

   (b) a puttable bond is a type of debt instrument that gives the holder of the bond the right, but not the obligation, to demand early repayment of the principal.

[13] Regulation (EU) No 575/2013 of the European Parliament and of the Council of 26 June 2013 on prudential requirements for credit institutions and investments firms and amending Regulation (EU) No 648/2012 (OJ L 176, 27.6.2013, p.1).

3. Implementation

Date of application

10.These guidelines apply from 1 March 2017.

4. Correction to the modified duration to reflect prepayment risk

11. For the purposes of the correction of the modified duration calculation for all debt instruments subject to prepayment risk, referred to in the second subparagraph of Article 340(3) of Regulation (EU) No 575/2013, institutions should apply one of the following:

(a) the formula set out in paragraph 12;

(b) the formula set out in paragraph 13.

12. For the purposes of paragraph 11(a) institutions should apply the following formula to correct the Modified Duration and compute a Corrected Modified Duration ('CMD'):

$$CMD = MD \times \Phi \times \Omega$$

where:

$MD = modified\ Duration\ as\ in\ Art. 340(3)$

$\Phi = \frac{B}{P}$

$\Omega = 1 + \Delta + \frac{1}{2}\Gamma dB + \Psi$

$\mathrm{P} = price\ of\ the\ bond\ with\ the\ embedded\ optionality$

$\mathrm{B} = \text{theoretical}\ price\ of\ the\ vanilla\ bond$

$\Delta = delta\ of\ the\ embedded\ option$

$\Gamma = gamma\ of\ the\ embedded\ option$

Ψ = where not considered in the calculation of Δ and Γ, and where material, additional factor for transaction costs and behavioural variables consistent with an Internal Rate of Return ('IRR') shift of 100 basis points ('b.p.')

$dB = Change\ in\ value\ of\ the\ underlying.$

13. For the purposes of paragraph 11(b), institutions should apply the following formula to re-compute directly the CMD by repricing the instrument after a shift of 100 b.p. in the IRR:

$$CMD = \frac{\mathrm{P}_{-\Delta r} - \mathrm{P}_{+\Delta r}}{2 \times \mathrm{P}_0 \times \Delta r} + \Psi$$

where:

$\mathrm{P}_0 = the\ current\ market\ price\ of\ the\ product;$

$\mathrm{P}_{\mp\Delta r} = theoretical\ price\ of\ the\ product\ after\ a\ negative\ and\ a\ positive\ IRR\ shock\ equals\ to\ \Delta r;$

$\Delta r = hypothetical\ IRR\ change\ of\ 50\ b.p.$

Ψ= where not considered in the calculation of $\mathrm{P}_{(\mp\Delta r)}$, and where material, additional factor for transaction costs and behavioural variables consistent with a IRR shift of 100 b.p.

14. The computation of the additional factor Ψ need only to be considered if material and should never lead to a shorter CMD than if it had not been considered in the calculation.

15. For the purposes of assessing the additional factor Ψ in accordance with paragraph 13 of these guidelines, institutions should take into account all of the following:

    a. that transaction costs reduce the value of the option, making the option unlikely to be executed below the threshold established by the transaction costs;

    b. that there are behavioural factors suggesting that some clients, in particular retail clients, may not always exercise an option, despite it being in the money, due to some known circumstances including the following:

    (i) where the remaining principal is close to the initial amount lent, leading some 'aggressive' borrowers to leave or refinance at an early stage;
    (ii) in the case of borrowers with the largest loan size who have the largest gain from prepayment as the cost attached to prepayment is a fixed amount.

16. The assessment of the additional factor Ψ should be based on historical data, obtained from the institutions' own experience or from external sources. Data on the behavioural factors referred to in paragraph 15(b) may be obtained from the assessment of other balance sheet elements subject to prepayment risk, such as those observed for retail clients in the non-trading book.

17. Institutions should calibrate the additional factor Ψ by assessing significant divergences between the real behaviour historically observed for a type of client and the theoretical behaviour that would have been envisaged for counterparties acting in a purely rational way.

18. The calibration of the additional factor Ψ , due to behavioural factors referred to in paragraph 17, should be made where a relevant amount of these instruments with prepayment risk are held in the trading book and especially where the counterparties are retail clients. Additional factors should not be considered for the embedded options where the institution has the right to call for an early termination of the instrument.

Technical Annex

Illustration of the Corrected Modified Duration formula applied in the guidelines

It is possible to represent price of the Bond with the embedded optionality (P) as the s sum of the prices of two plain instruments: the price of the vanilla Bond (B) and (C) the price of the embedded bond option (short call or long put). We also know that the price of the vanilla Bond (B) is a function of r, the interest rate curve, so B = g(r), and C is a function of the underlying vanilla Bond price, so C = f(B), i.e. C = f[B(r)].

From the initial statement, we can write this as in Eq. 1):
Eq. 1) $P = B + C$

From Eq. 1 it follows:
Eq. 2) $dP = dB + dC$

We also know that:
Eq. 3) $dB = \frac{dB}{dr} dr$

So, according to a Taylor approximation:

Eq. 4) $dC = \frac{dC}{dB} dB + \frac{1}{2} \frac{d^2C}{dB^2} (dB)^2$

Using standard Greeks derivatives nomenclature, we may call:

Eq. 5) $\Delta = \frac{dC}{dB}$
Eq. 6) $\Gamma = \frac{d^2C}{dB^2}$

Substituting Eq. 5 and 6into Eq. 4, and then Eq. 4 into Eq. 2, to obtain:

Eq. 6) $dP = dB + \Delta\, dB + \frac{1}{2}\, \Gamma\, (dB)^2$

We can regroup dB, and call:
Eq. 7) $\mathrm{K} = 1 + \Delta + \frac{1}{2}\, \Gamma\, dB$

The Modified Duration (MD) in the article 340 of the CRR can also be represented as follows:

Eq. 8) $\mathrm{MD}_{(\mathrm{B})} = -\frac{1}{B} \frac{dB}{dr}$

And we introduce the ratio:
Eq. 9) $\Phi = \frac{B}{P}$

And, similar to Eq. 8, we can write the (Corrected) Modified Duration of the Bond with the embedded option, which is the objective of EBA mandate on prepayment risk, as the sensitivities of the price of the Bond (P) with respect the interest rate (r), divided by the price of the bond:

Eq. 10) $\mathrm{MD}_{(\mathrm{P})} = -\frac{1}{P}\frac{dP}{dr}$

At this point we can simply substitute Eq. 6 and 7into Eq. 10 (just substitute $\mathrm{MD}_{(\mathrm{P})}$ with CMD (equation 11), and using definition in equation 8 and 9, we obtain:

Eq. 11) $\mathrm{CMD} = \mathrm{MD}_{(\mathrm{B})} \times \Phi \times \mathrm{K}$

The EBA is also consulting on a third adjustment to the duration to reflect eventual transaction cost and behavioural factors which, when significant, may also affect the duration of the bond. The additional effect should be represented as follow:
Eq. 12) $\Psi = Additional\ factors$
Then, we can write the K of equation 7 as:

Eq. 13) $\Omega = 1 + \Delta + \frac{1}{2}\,\Gamma\, dB + \Psi$

And Eq. 11 should be rewritten as presented in the guideline:

Eq. 14) $\mathrm{CMD} = \mathrm{MD}_{(\mathrm{B})} \times \Phi \times \Omega$

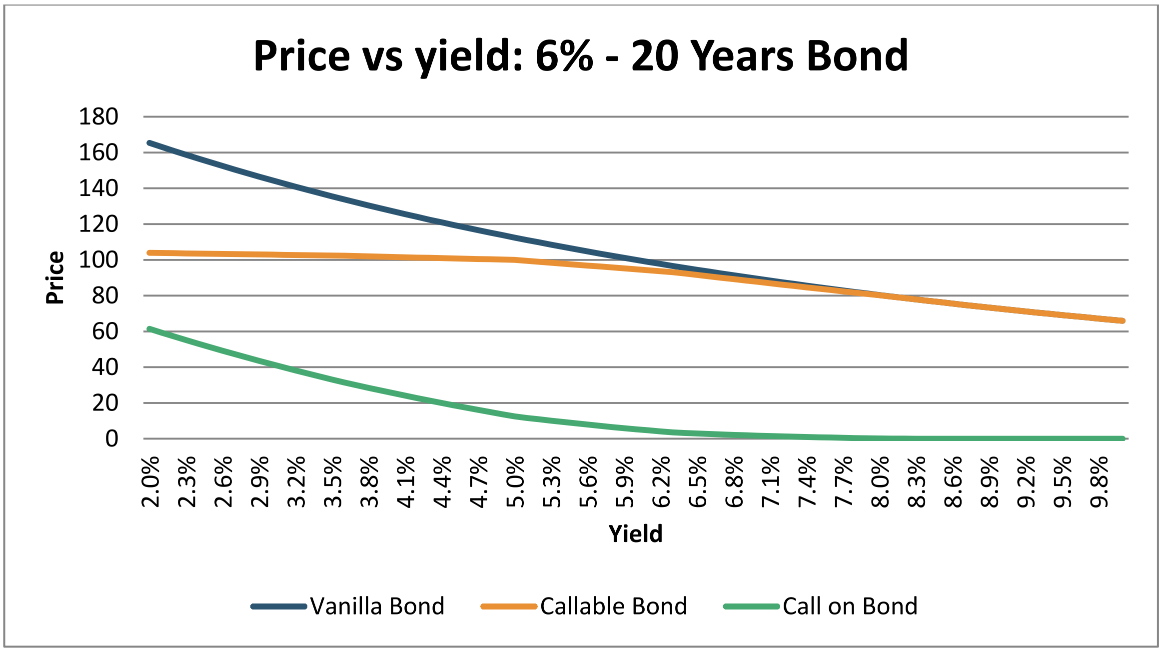
It is noted that the dB (equation 3) in the equation 13 should be consistent with the change in value of the bond, with respect the change in the interest rate.
Finally, it is noted that the formula in Eq. 14 and Eq. 10 are represented with Δ and Γ (equations 5 and 6) computed as respect the change value of the price of the Bond (dB, in equation 3).
Clearly those Greeks can be valued also as respect the change in value of interest rate, because we know that C = f[B(r)].

Eq. 15) $\Delta_r = \frac{dC}{dr} = \frac{dC}{dB}\frac{dB}{dr} = \Delta\,\frac{dB}{dr}$

And:
Eq. 16) $\Gamma_r = \frac{d^2C}{dr^2} = \frac{dC}{dB}\frac{d^2B}{dr^2} + \left(\frac{dB}{dr}\right)^2 \frac{d^2C}{dB^2} = \frac{dC}{dB}\frac{d^2B}{dr^2} + \left(\frac{dB}{dr}\right)^2\, \Gamma$

From equation 15 and 16 is straightforward to obtain Δ and Γ to be applied in the formulation 13.

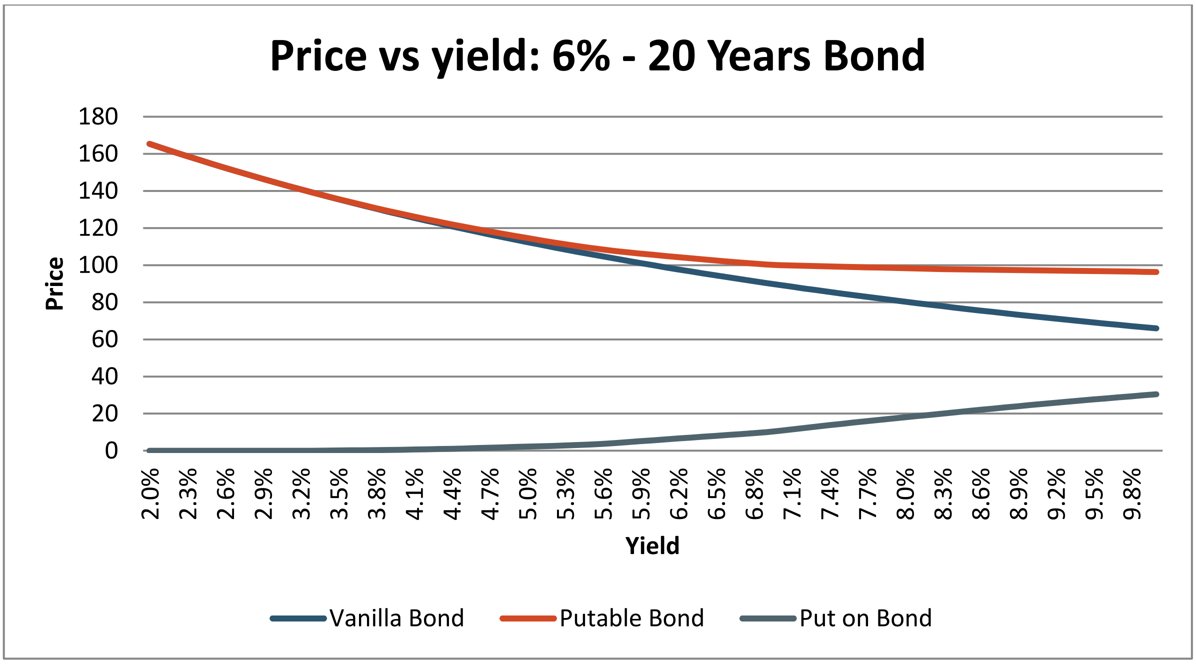
Figure 1: Price-yield relationship for the bond, the callable bond and the call on the bond.



In Figure 1 we can observe the relationship price-yield of a callable bond. As the shocks on the yield curve move form the par value (6% in the example), increase the yield (e.g moves up to 8%), both the price of the vanilla bond and the callable bond decrease.

It is notable how the price of the two bond tend to converge when the yield increases. However, when the yield decreases (e.g moves down to 4%) the call option moves ITM and the price of the two bonds diverge; the vanilla bond price raises significantly and the callable bond tends to be capped at 100.

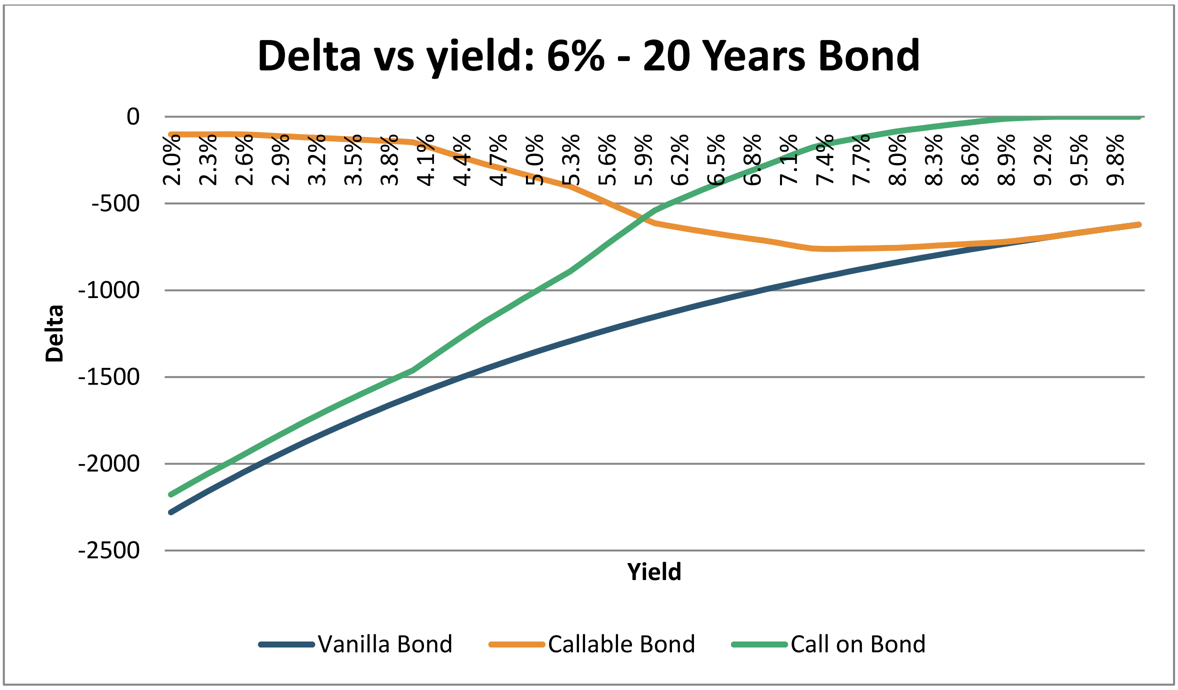
Figure 2: Price-yield relationship for the bond, the puttable bond and the put on the bond.



In Figure 2 we can observe the same relationship price-yield of figure 1 but for a puttable bond. As the yield curve decreases (e.g goes to 4%), both the price of the vanilla bond and the puttable bond increase.

It is notable how the price of the two bonds tend to converge when the yield decreases. However, when the the yield increase (e.g moves up to 8%) and the put option moves ITM, the price of the two bond diverge: the vanilla bond price decreases significantly, while the puttable tends to be flored near 100.

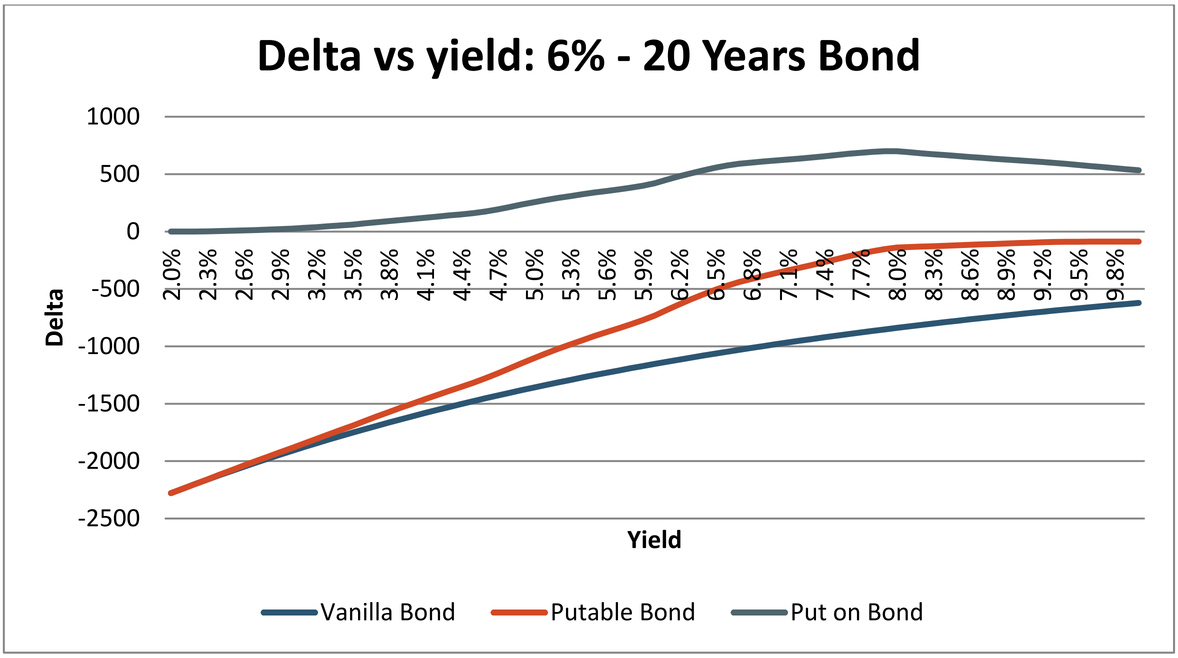
Figure 3: Delta-yield relationship for the bond, the callable bond and the call on the bond.



In Figure 3 we can observe the relationship delta-yield of a vanilla bond, a callable bond and a call on the vanilla bond. We note that the sensitivities is always negative for the 3 instruments. We can observe that the sensitivities of the callable bond is always smaller than the sensitivities of the vanilla bond. Actually the sensitivities of the callable bond is equal to the difference of the sensitivities of the vanilla bond and the embedded option.

For this reason when the option is ITM, the sensitivities of the option is really close to the sensitivity of the bond, so the sensitivities of the callable bond, for yield far lower than the par (e.g 4%) is close to zero. On the other hand, for yield much higher than the par yield (e.g. 8%) the delta sensitivities of the option (OTM) tends to zero, and the vanilla and callable bond delta sensitivities tend to converge.

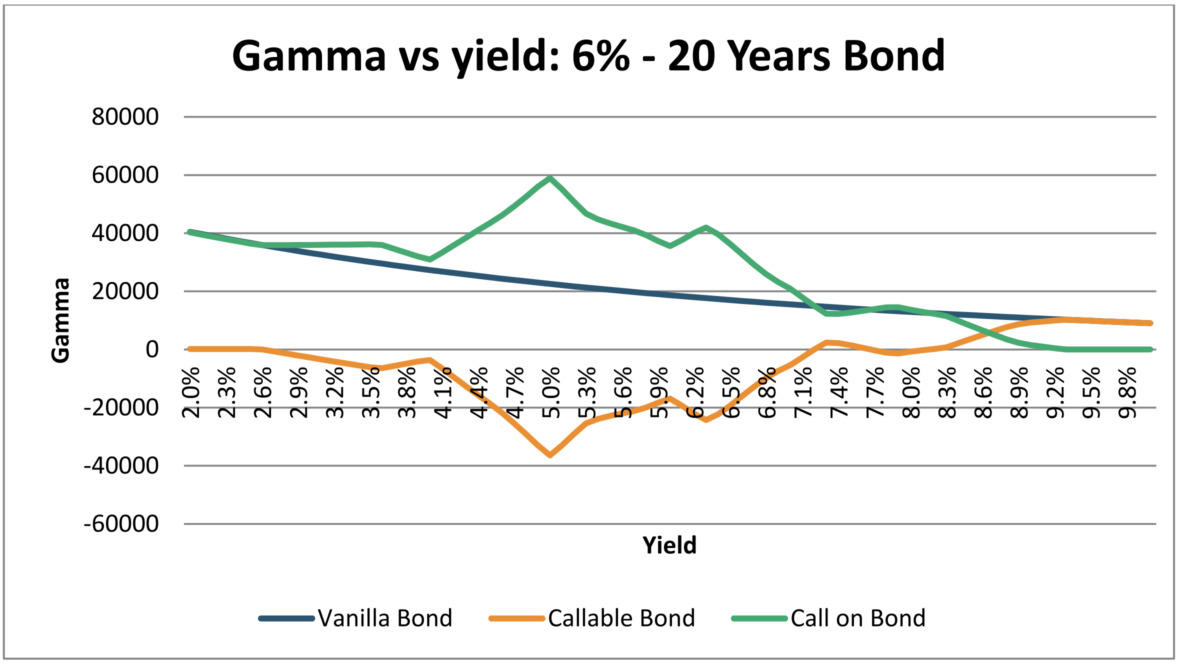
Figure 4: Delta-yield relationship for the bond, the puttable bond and the put on the bond.



In Figure 4 we can observe the relationship delta-yield of a vanilla bond, a puttable bond and a put on the vanilla bond. We note that the sensitivities is always negative for the bond, but it is positive for the put option. We can observe that the sensitivities of the puttable bond is always smaller than the sensitivities of the vanilla bond.

When the option is ITM, the sensitivities of the option is really close to the sensitivity of the bond, so the sensitivities of the puttable bond, for yield far higher than the par (e.g 8%) is close to zero. On the other hand, for yield much lower than the par yield (e.g. 4%) the delta sensitivities of the put option (OTM) tends to zero, and the vanilla and puttable bond delta sensitivities tend to converge.

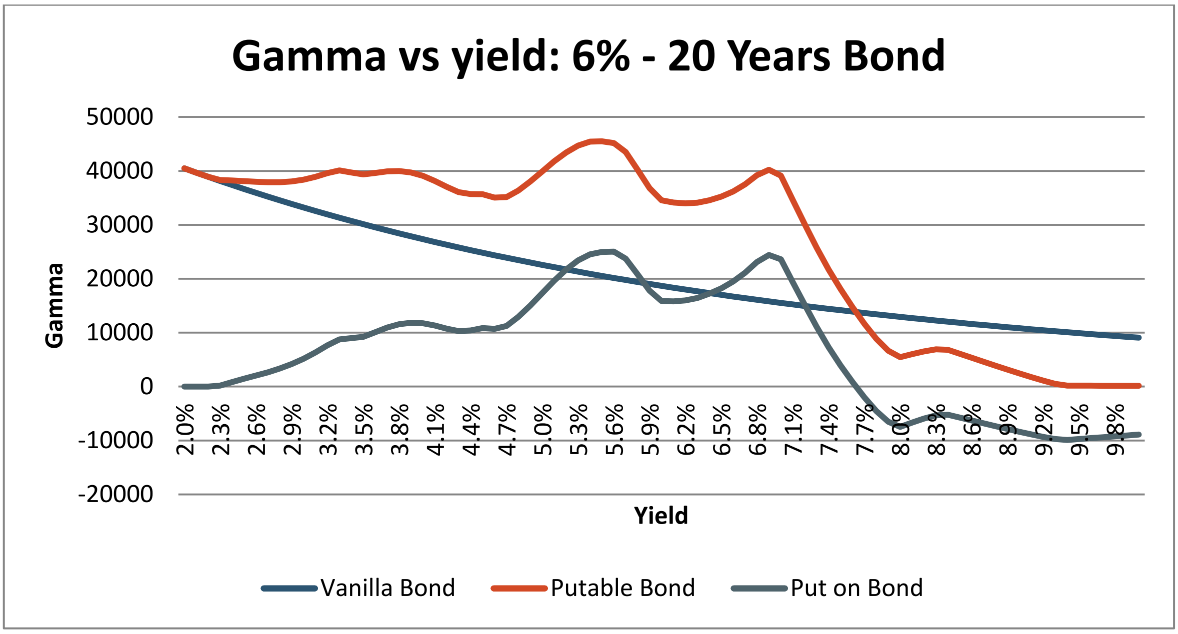
Figure 5: Gamma-yield relationship for the bond, the callable bond and the call on the bond.



In Figure 5 we can observe the relationship gamma-yield of a vanilla bond, a callable bond and a call on the vanilla bond. We note that the sensitivities of the bond is always positive, while the gamma senistivities of the call option on the bond can be both positive and negative.

The gamma sensitivities of the call on the bond tend to be significantly negative for values closer to the par value of the bond (6%). The gamma sensitivities of the option tends to zero the more we move far from the par yield, so gamma sensitivities for the vanilla bond and the callable bond tend to converge for value of the yield far from the par yield.

Figure 6: Gamma-yield relationship for the bond, the puttable bond and the put on the bond.



In Figure 6 we can observe the relationship gamma-yield of a vanilla bond, a puttable bond and a put on the vanilla bond. We note that the sensitivities of the bond are always positive, while the gamma sensitivities of the put option on the bond can be both positive and negative.

We can observe that the gamma sensitivities of the call on the bond tend to be higher for values closer to the par value of the yield (6%). The gamma sensitivities of the option tends to zero the more we move far from the par yield, so gamma sensitivities for the vanilla bond and the puttable bond tend to converge for value of the yield far from the par yield.

4. Accompanying documents

4.1 Draft cost-benefit analysis / impact assessment

Article 340(3) of the CRR requires the EBA to develop guidelines on the application of the corrections to the calculation of the modified duration for debt instruments which are subject to prepayment risk.

As per Article 16(2) of the EBA regulation (Regulation (EU) No 1093/2010 of the European Parliament and of the Council), any guidelines developed by the EBA shall be accompanied by an Impact Assessment (IA) annex which analyses 'the potential related costs and benefits'. Such annex shall provide the reader with an overview of the findings as regards the problem identification, the objectives, the options identified to remove the problems and their potential impacts. This annex presents the IA with a cost-benefit analysis of the provisions included in the guidelines described in this Consultation Paper.

A. Problem identification

The duration-based calculation of general risk is one methodology that the EU institutions may follow to calculate own funds requirements against general risk on debt instruments.[14] Prepayment risk refers to an early unscheduled return of principal and the specifications of the duration-based calculation under Article 340 of the CRR do not account for this risk. The core problem that the current guidelines aim to address is the risk associated with the uncertainty around the return of principal on a fixed-income security, and in this case on debt instruments.

For instance, the issuer of a callable bond, i.e. a bond with an embedded call option has an incentive to exercise the call, i.e. to redeem the bond in advance, when the interest rate in the market decreases and reissue/refinance the original debt at a lower rate.

Similarly, an investor holding a puttable bond, i.e. a bond with a put option embedded, has an incentive to exercise the put option, i.e. sell the bond back to the issuer when market interest rates increase.[15] By reinvesting at a higher rate the investor has a larger return on the debt instrument. The larger the spread between the rates, the higher the probability that the investor will use the put option.

[14] The other methodology is the maturity-based calculation of general risk.

[15] This example assumes that the initial contract is on a fixed-coupon basis and the investor is interested in coupon return.

The algebraic definition of the modified duration as defined under Article 340 does not account for the effect of the (call or put) option in the estimation of the price sensitivity of bond to yield. The conventional convexity of the price-yield curve for long (plain vanilla) bond positions or its concavity for short positions does not hold. More precisely:

Long positions				
Plain vanilla bond (convex)	-	call option (concave)	=	callable bond (concave when the option is ITM, convex as usual for deep OTM option
Plain vanilla bond (convex)	+	put option (convex)	=	puttable bond (convex)
Short positions				
Plain vanilla bond (concave)	-	call option (convex)	=	callable bond (convex when the option is ITM, concave as usual for deep OTM option
Plain vanilla bond (concave)	+	put option (concave)	=	puttable bond (concave)

It is clear that the embedded option changes the price sensitivity of bond to yield and can lead to underestimation of losses such as in the cases of a long callable bond position and a short puttable bond position.

Therefore, the current framework ignores such prepayment risk and hence it is not considered in the associated own funds requirements. This can jeopardise the level playing field in the EU banking sector, especially in terms of cross-border arrangements. Some Member States have national regulations adjusting the duration-based calculation to incorporate the prepayment risk; therefore, in theory institutions subject to this regulation have to correct[16] own funds against this risk while in other EU jurisdictions institutions are not subject to capital requirements under prepayment risk.

Policy objectives

The main objective of the current guidelines is to incorporate into the current duration-based calculation of general risk a correction term for the modified duration. In other words, the objective is to correct the calculation of the modified duration so that the estimation of the price-yield sensitivity and of associated own funds requirements internalises the prepayment risk inherent to debt instruments, e.g. debt instruments with embedded options. This correction is expected to provide a more accurate estimation of price sensitivity and adjust the methodology for the potential underestimation of losses and overestimation of gains.

[16] Below it is shown that the own funds requirements would actually decrease when the prepayment risk is taken into account.

The correction is also expected to contribute to a level playing field and further harmonisation of the estimation of own funds requirements across EU jurisdictions and institutions.

The table below summarises the objectives of the current guidelines:

Problems to be addressed	Specific objectives	General objectives
Methodology is insensitive to prepayment risk	Risk adjustment of the modified duration to calculate own funds requirements	Improving the general risk sensitivity of debt instruments
Inaccurate calculation of own funds requirements	Addressing issues related to overestimation of losses	Differentiating the risk profiles of EU institutions more accurately
Lack of clear and common framework across the EU	Harmonisation of the general market risk methodology across EU institutions	Contributing to a level playing field across EU institutions

Baseline scenario

COREP data (as of Q3 2015) show that there are currently 37 EU institutions that use the duration-based approach in order to calculate for debt instruments the own funds requirements against general market risk. Note that the data from COREP for the current analysis are based on the C 18.00 template and cover 125 institutions[17] across 26 EU Member States and Norway. The total assets figure of the sample is about EUR 25,070 billion corresponding to approximately 60% of the total EU sample[18]. Country and bank level data on total assets have been extracted from FINREP[19].

Table 1 shows the number of institutions that use the maturity-based approach and/or the duration-based approach by jurisdiction. Currently, in the EU, only Denmark has a methodology accounting for the instruments with pre-payment risk in the calculation of own funds requirements. If national jurisdictions do not have any similar regulatory provisions in place then the current guidelines are expected to have an impact on the institutions using the duration-based approach provided that the trade in debt instruments has prepayment risk.

Table 1 indicates that about 30% of the institutions use the duration-based approach to calculate the own funds requirements for traded debt instruments. The total assets of these institutions are EUR 11,622 billion, 46% of the sample considered for the current analysis. This indicates that, on

[17] The total number of institutions available in COREP template C 18.00 is 135. Some institutions have been dropped from the analysis since all values for the positions under both maturity-based and duration-based approaches are zero. The analysis team did not categorise these institutions under the SA.

[18] The aggregate EU total assets figure (EUR 47,074 billion) is based on EBA statistics and includes 28 EU Member States and Norway. http://www.eba.europa.eu/supervisory-convergence/supervisory-disclosure/aggregate-statistical-data

[19] Note that the sample between COREP and FINREP is not consistent, therefore for a number of institutions that are considered for the analysis (based on COREP) the total assets figures (FINREP) are not available. This underestimates the total assets of the sample for the analysis.

average, banks using the duration-based approach are larger in size than those using the maturity-based approach. Table 1 further presents by jurisdiction descriptive statistics specific to the institutions using the duration-based approach.

The aggregate volume of the (short and long) gross/non-netted positions under the duration-based approach in the sample is EUR 7,223 billion (not shown). For both short and long positions, about 65% of the positions fall under maturity zone 1, 12% under maturity zone 2 and the remaining 23% under maturity zone 3 (not shown).[20]

The corresponding own funds requirements with the (short and long) positions under the duration-based approach are EUR 1,201 million (not shown). The share of own funds requirements for these positions under the duration-based approach is about 17% of the total corresponding own funds requirements under both the maturity-based and duration-based approaches. This is reasonable given that the share of positions under the duration-based approach is about 11% of the total positions including both the maturity-based and duration-based approaches. The overview suggests that the guidelines would have a greater impact on DK, FR, UK, IT and NO, i.e. jurisdictions where the institutions have a relatively large volume of (long and short) positions under the duration-based approach.

The figures on banks using the duration-based approach include both traded debt instruments with and without prepayment risk. Of these (EUR 7,223 billion) positions an average of 8% is expected to include prepayment risk. In other words, an estimated total position of EUR 578 billion with prepayment risk would be impacted by the current guidelines. The statistics suggest that approximately 1% of the total positions under the standardised rules (including both the maturity-based and duration-based approaches) fall under the scope of the current guidelines. About 80% and 20% of these positions are callable (EUR 462.3 billion) and puttable (EUR 115.6 billion) debt instruments, respectively.[21]

When jurisdictions have already in place regulatory provisions accounting for the prepayment risk in the duration-based approach, the impact is expected to be less or none for the institutions under these jurisdictions.

[20] The maturity zones are as described in COREP template C 18.00 the share figures are rounded and decimals points are ignored.

[21] As of 3 February 2016, there are 142,715 active debt instruments in the EU market of which 11,673 are with embedded call (9,255) or put options (2,418). The analysis is based on Bloomberg public data.

Table 1 Descriptive statistics on EU institutions with duration-based approach as of Q3 2015 (monetary values are expressed in EUR million)

	Sample-related statistics				Descriptive statistics on banks using duration-based approach					
	No. of banks in the analysis sample	Total assets of the banks in the sample (i.e. asset coverage of the sample)	No. of banks using maturity-based approach	No. of banks using duration-based approach	No. of banks using both approaches	Share of banks using duration-based approach	Total assets of banks using duration-based approach	Asset share of the banks using duration-based approach in total assets	Share of duration-based positions in total positions	Own funds requirements of the banks with duration-based approach	Own funds share of the banks with duration-based approach in total own funds
AT	6	451,396	6	0	0	0%	0	0%	0%	0	0%
BE	4	785,515	3	1	0	25%	35,751	5%	47%	12	22%
BG	2	14,552	2	0	0	0%	0	0%	0%	0	0%
CY	2	7,511	2	0	0	0%	0	0%	0%	0	0%
CZ	2	72,126	2	0	0	0%	0	0%	0%	0	0%
DE	10	1,814,307	5	6	1	60%	1,129,075	62%	35%	226	33%
DK	3	276,151	0	3	0	100%	276,151	100%	100%	165	100%
EE	2	14,326	1	1	0	50%	9,179	64%	0%	0	15%
ES	9	2,673,869	9	0	0	0%	0	0%	0%	0	0%
FI	2	133,948	1	1	0	50%	102,553	77%	34%	69	91%
FR	8	6,624,317	6	4	2	50%	4,361,704	66%	67%	223	74%
GB	15	7,330,717	13	4	2	27%	3,006,183	41%	1%	142	5%
GR	3	266,677	3	0	0	0%	0	0%	0%	0	0%
HR	3	37,110	3	0	0	0%	0	0%	0%	0	0%
HU	4	55,447	1	3	0	75%	47,745	86%	77%	27	82%
IE	4	258,298	2	2	0	50%	219,852	85%	99%	42	91%
IT	14	2,173,040	13	3	2	21%	1,625,813	75%	70%	158	23%
LT	3	16,959	2	1	0	33%	6,364	38%	7%	2	33%
LU	4	168,774	4	0	0	0%	0	0%	0%	0	0%
LV	3	13,613	2	1	0	33%	5,276	39%	63%	0	85%
NL	2	475,001	2	0	0	0%	0	0%	0%	0	0%
NO	2	330,832	0	2	0	100%	330,832	100%	100%	71	100%
PL	3	131,887	1	2	0	67%	100,068	76%	59%	46	65%
PT	6	299,069	5	1	0	17%	76,330	26%	10%	4	3%
RO	3	34,548	3	0	0	0%	0	0%	0%	0	0%
SE	3	591,681	1	2	0	67%	289,339	49%	34%	11	18%
SI	3	18,797	3	0	0	0%	0	0%	0%	0	0%
Total	**125**	**25,070,467**	**95**	**37**	**7**	**30%**	**11,622,215**	**46%**	**11%**	**1,201**	**17%**

Source: COREP and FINREP data as of Q3 2015

Impact of the correction on own funds requirements

When the duration-based approach accounts for the prepayment risk, the corresponding level of own funds requirements is expected to fall. The background section (Section 3.2 in particular) of the draft CP explains in detail the logic for the argument.

It is therefore expected to observe in the baseline that for a given volume of positions own funds requirements for institutions in jurisdictions where the methodology already accounts for prepayment risk are lower than the own funds requirements in countries where such regulatory provisions do not exist. However this cannot be assessed based solely on COREP data. A reason is that country level data are not available for the share of positions with prepayment risk, i.e. the data do not display the share of positions with prepayment risk in each jurisdiction.

In addition, it is challenging to capture the variations due to such implementations since the data have been extracted in an economic environment where the interest rates are low. This point is important because it implies that the institutions are operating in the money and, for a call option (which forms a large part of the debt trade with prepayment risk), the option's strike price is below the price of the underlying asset. In other words, it is very likely that that the banks have used the call options long before the market rates hit their current low levels.

Assessment of the options considered and the preferred option(s)

a. Inclusion/exclusion of the gamma factor in the correction formula

The rationale for discussing whether the formula calculating the corrected modified duration should include the gamma factor or not is based on the underestimation of losses. Underestimation of losses occurs when the counterparty takes a long position in a callable bond or when it takes a short position in a puttable bond.

The major disadvantages of the inclusion of the gamma factor are:

i) It is more costly for banks to calculate the gamma factor. There are currently only a few banks (in Denmark) that have similar provisions that account for the prepayment risk. Therefore, calculating the gamma factor for a bond with an embedded option will increase costs for most of the banks in the EU.

ii) Adding the gamma factor may increase the complexity of the guidelines for correcting the modified duration.

However, the inclusion of the gamma factor is expected to have the following advantages:

i) It adjusts for convexity (for long positions) and concavity (for short positions), and provides a more accurate estimate to capture risk associated with the positions.

ii) It is a more prudent approach to capturing the risk associated with the positions.

iii) Inclusion of gamma is in line with the EBA regulation on non-delta risk (EBA/2013/16). Convexity risk is accounted for in the calculation of own funds requirements.

The analysis team argues that the expected benefits of the inclusion of the gamma factor will exceed the potential costs associated with the exclusion of the option. Therefore, the inclusion of the gamma factor is the preferred option.

The cost associated with the option will fall on the institutions. The institutions that fall under the scope of the current guidelines will need to use an appropriate pricing model to obtain the gamma factor for positions with prepayment risk. Since the Level 1 text does not require any pre-authorisation for the adaptation of the duration-based approach, the current guidelines do not require pre-authorisation for the gamma factor in the calculation of corrected modified-duration. Therefore, the guidelines would not create additional cost for the competent authorities.

b. Inclusion/exclusion of the behavioural factors in the correction formula

The inclusion of the behavioural factors aims to provide a more precise interpretation of the prepayment risk. When such factors are significant they can have a great impact on the duration of the bond. The practice is also in line with the BCBS framework on the Fundamental Review of the Trading Book, where behavioural risk is defined as a risk of a change in exercise/prepayment outcomes, e.g. in fixed-rate mortgage products, due to other retail client decision motivating factors, such as demographical features and/or and other social factors, rather than pure financial gain. As well as being more accurate it also provides a more conservative approach as the factor is always positive, i.e. the corrected modified duration will increase with the factor.

Another advantage of the practice is that it does not apply a rigid specific formula and therefore gives the parties some discretion depending on the materiality of the behavioural factors. Institutions with limited portfolios and for which the behavioural factors have no historical relevance do not have to estimate the factors on a regular basis.

The analysis team argues that the benefits associated with the inclusion of the behavioural factors would exceed the costs, such as those arising from the complexity of the methodology and further cost to institutions.

The source of potential costs to the institutions is from the observation of portfolio behaviour in historical data. On the other hand, in line with the Level 1 text the guidelines do not introduce any approval process for the behavioural factors; therefore, the expected cost to the competent authorities is none.

4.2 Feedback from the public consultation

During the public consultation period (22/03 – 22/06/2016) the European Banking Authority received one response, available on the EBA website, here below summarised. The Banking Stakeholder Group did not provide any feedback for this Guideline.

Comments	Summary of responses received	EBA analysis	Amendments to the proposals
Responses to questions in Consultation Paper EBA/CP/2016/03			
Question 1: Do stakeholders agree with the proposed approaches to correct the modify duration?	The respondent argued in favour of the second approach as the first approach requires banks to value the derivative separately which is difficult to do. Furthermore, the bifurcation of the derivative is also not in line with the FRTB and the accounting framework.	Institutions are allowed to use either Option 1 or Option 2 (see Paragraph 11 of the GL).	None
Question 2: Do stakeholders agree that, under the 1st approach, the negative gamma stemming from the embedded option should be considered in the calculation of the correction?	The respondent calls for a revision of the first approach to consider gamma effects in all cases (i.e. including it for short callable and long puttable positions with positive gamma effects) such that hedging effects are recognised. This would also be more consistent with the FRTB.	The EBA agrees it is sensible to consider positive and negative gamma to increase the relevance of the CMD metric and avoid disincentivising proper management practices (due to the possibility of 'broken hedges').	The final draft GL request the gamma correction both when it is positive and when it is negative
Question 3: Do stakeholders agree with the inclusion of behavioural factors in the calculation of the corrections?	The respondent points out that in practice, additional factors are included in institutions' valuation models, for example for the valuation of mortgage-backed securities. Furthermore, respondent would welcome the confirmation from the EBA that the intention is not to require a separate valuation of additional factors if such are already included in an institution's repricing	The final GL allow the additional factor to be reflected either in the Delta, Gamma (under the first methodology) and price change (under the second methodology) or, alternatively, as a separate additional factor.	Flexibility in the computation of the additional correction factor to the CMD has been introduced

Comments	Summary of responses received	EBA analysis	Amendments to the proposals
	methodology		
Question 4: In case the approaches proposed to correct the negative gamma and/or the behavioural factors are deemed to be too burdensome, what simpler alternative adjustments may be applied to correct the modified duration?	The respondent agrees that the gamma effect should be considered but does not agree with the negative gamma methodology proposed under the first approach and suggests that the gamma effect should be included irrespective of whether the effects are positive or negative. Finally, under both approaches the behavioural factors should not constitute an additional adjustment but be included in the duration computed using institutions valuation models in case it is material.	No alternative adjustment was proposed.	None