EBA/GL/2016/09

04/01/2017

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[1]. 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 06.03.2017. 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/2016/09'. 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).

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[1] 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[2].

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.

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[2] 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:

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

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

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

$P = price\ of\ the\ bond\ with\ the\ embedded\ optionality$

$B = theoretical\ price\ of\ the\ vanilla\ bond$

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

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

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:

$$CMD = \frac{P_{-\Delta r} - P_{+\Delta r}}{2 \times P_0 \times \Delta r} + \Psi$$

where:

$P_0 = the\ current\ market\ price\ of\ the\ product;$

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

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

Ψ = where not considered in the calculation of $P_{(\mp\Delta r)}$, 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) $K = 1 + \Delta + \frac{1}{2} \Gamma\, dB$

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

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

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

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

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

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

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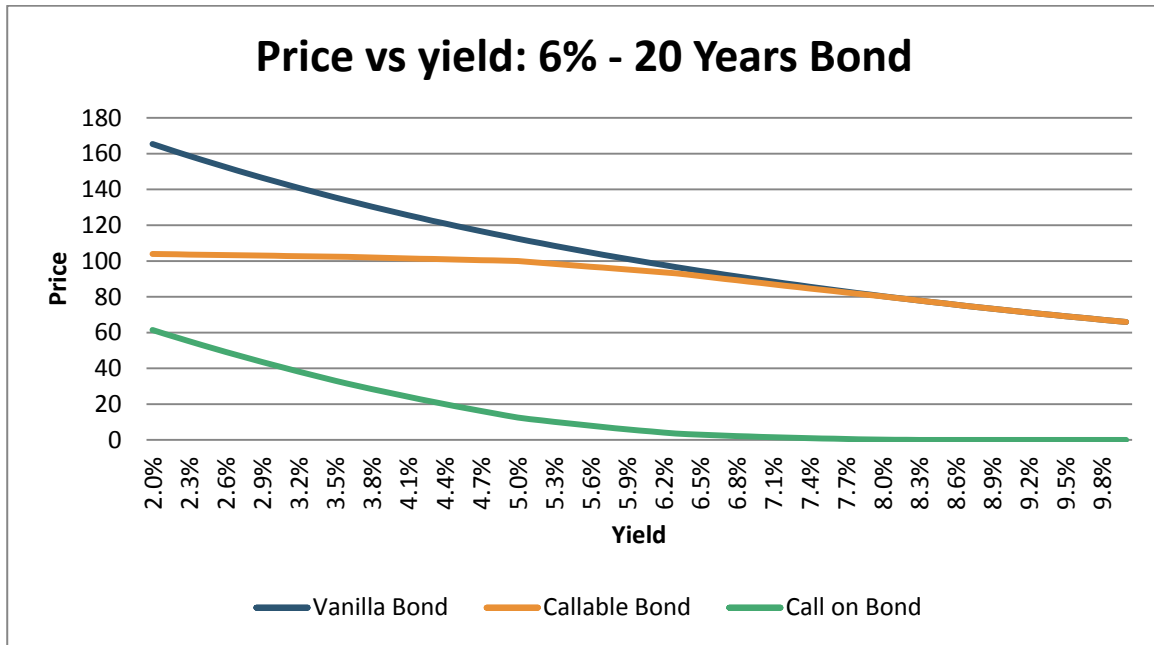
Eq. 15) $\Delta_r = \frac{dC}{dr} = \frac{dC}{dB}\frac{dB}{dr} = \Delta\frac{dB}{dr}$

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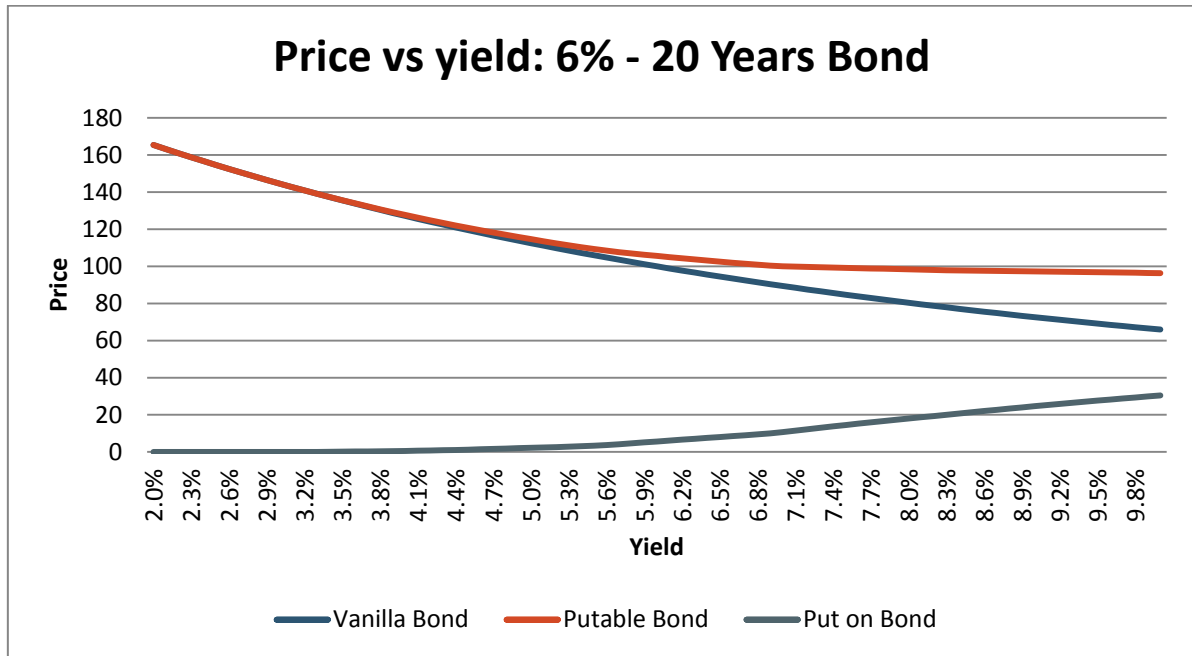
Figure 1: Price-yield relationship for the bond, the callable bond and the call on the bond.

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.

Price vs yield: 6% - 20 Years 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.
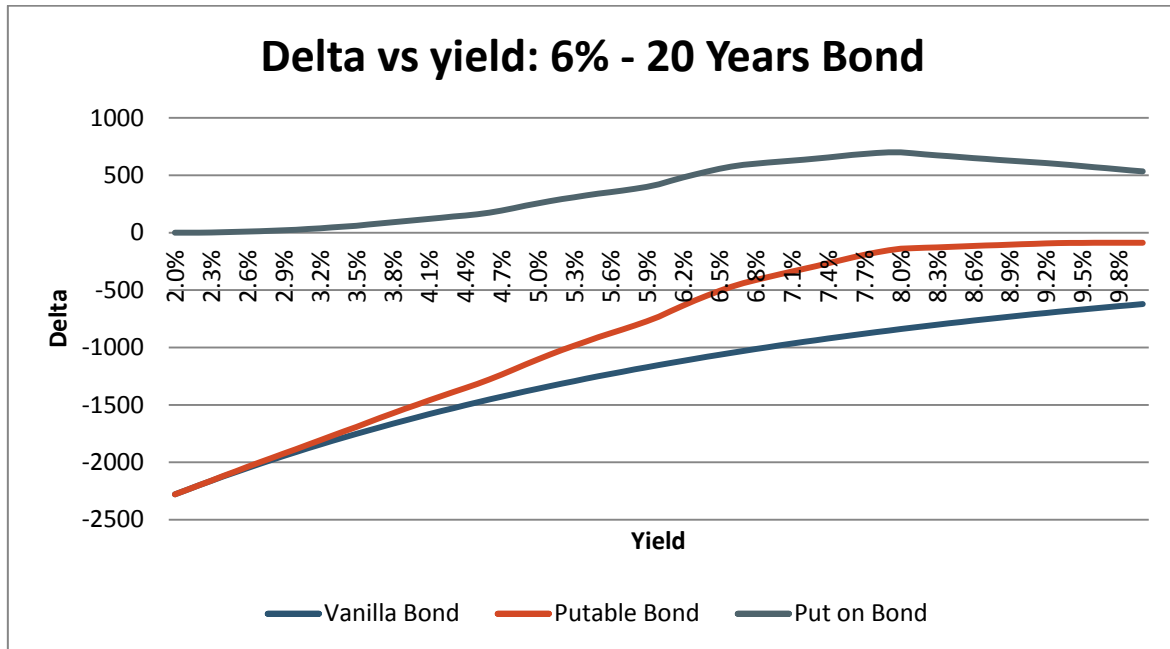
Figure 3: Delta-yield relationship for the bond, the callable bond and the call on the bond.

Delta vs yield: 6% - 20 Years Bond
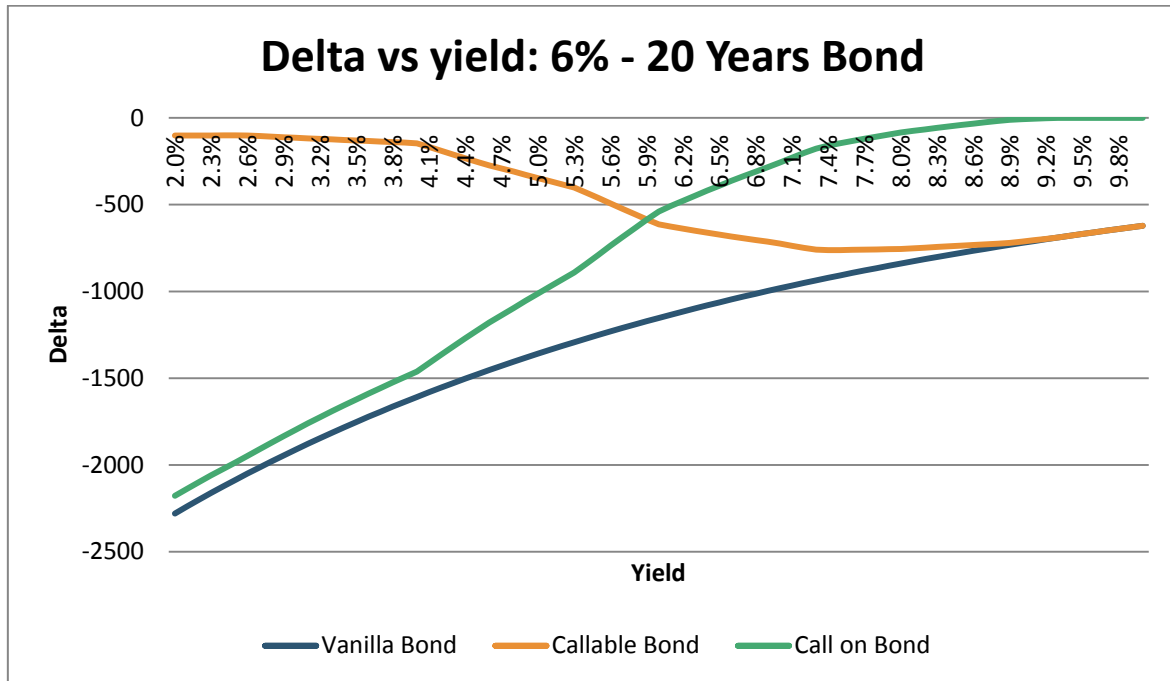
In Figure 3 we can observe the relationship delta-yield of a vanilla bond, a callable bond and a call on the vanilla bond. We note that the sensitivities is always negative for the 3 instruments. We can observe that the sensitivities of the callable bond is always smaller than the sensitivities of the 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.
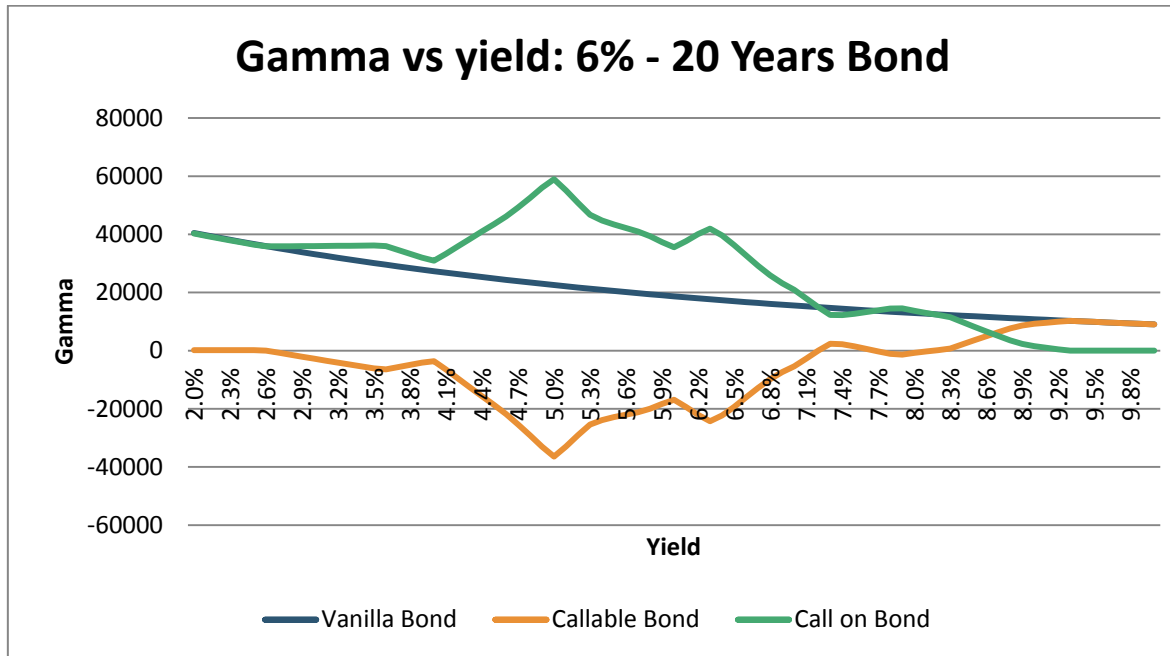
Figure 4: Delta-yield relationship for the bond, the puttable bond and the put on the bond.

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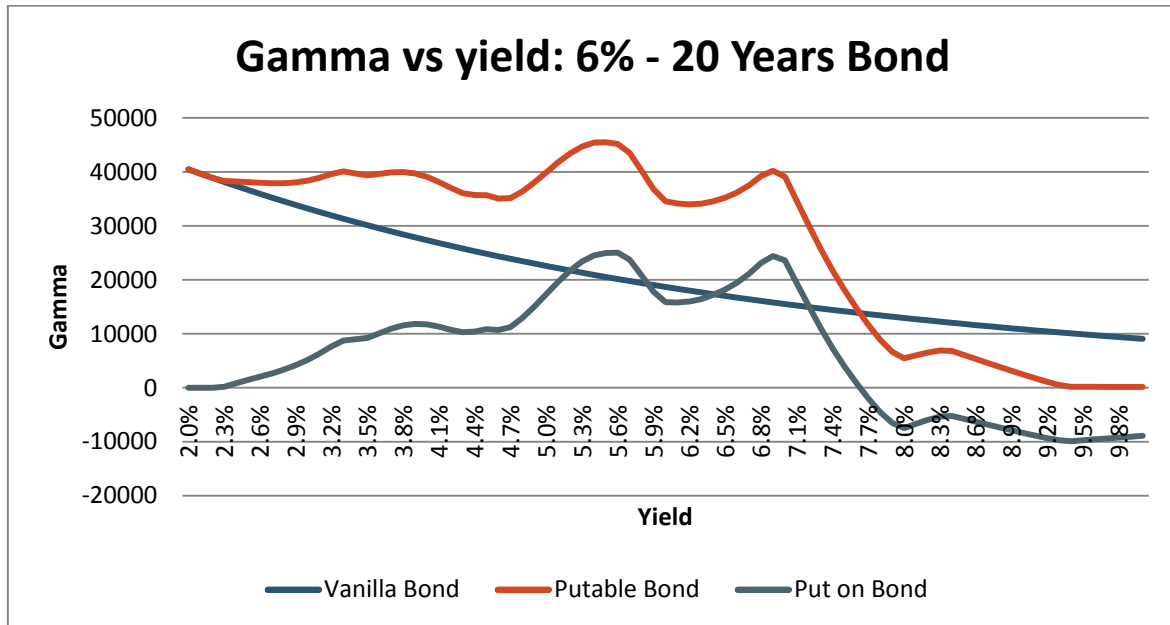
Figure 5: Gamma-yield relationship for the bond, the callable bond and the call on the bond.

Gamma vs yield: 6% - 20 Years 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.