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IFRS 16 INCREMENTAL BORROWING RATE: A METHODOLOGY PROPOSAL FOR LOSS GIVEN DEFAULT ADJUSTMENT

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ABSTRACT. The objective of our paper is to develop a model that is able to adjust the standard IFRS 16 IBR (obtained from unsecured bonds/loans yields) for reflecting a recovery rate in line with IFRS principles. The proposed model uses Credit Default Swaps (CDSs) quoted information as a basis for introducing the adjustment to standard IBR. It analyses the CDS spread change in response to changes in recovery rate and applies this change to the initial IBR.

1. Introduction

Under International Financial Reporting Standards (IFRS) issued by the International Accounting Standards Board (IASB), the standard regulating accounting for lease operations since 1994 (International Accounting Standard – IAS – 17) was replaced by a new standard (IFRS 16), which came into effect for reporting periods beginning on or after January 1, 2019.

The new standard is introducing significant changes in the accounting model to be applied by the lessees (maintaining the model for lessors basically unchanged in relation to previous standard). Under IAS 17 lessees had to classify all lease agreements in two categories: operating leases and finance leases. In operating leases, the lessee simply recognized a lease expense over the lease term (without recognizing assets or liabilities in the balance sheet) , while in the finance leases it recognized the leased good in the asset side (subject to amortization and impairment) and a debt in the liability side (with the corresponding interest expenses). In other words, the finance lease operation was basically accounted for as a financed purchase.

Under IFRS 16, the distinction between operating and finance leases disappears for lessees, and instead a capitalization model similar to the IAS 17 finance lease model is applied in all cases (apart from certain voluntary exceptions[1]) (see IFRS 16 lessee model development, including examples, in Morales-Díaz and Zamora-Ramírez, 2018). This change leads to the recognition of new assets (the leased goods) and new liabilities (for the present value of future lease payments) in relation to previous operating leases.

The new standard was jointly developed by the IASB and the FASB (Financial Accounting Standards Board), the body that issues accounting standards generally accepted in the US (US GAAP). The FASB standard (ASC – Accounting Standard Codification – Topic 842), while similar to IFRS 16, does also contain several differences. In both cases (IFRS 16 and ASC Topic 842), the main objective of lease accounting reform has been one and the same, i.e. to increase transparency and comparability. Both boards (IASB and FASB) considered that previous models permitted entities to maintain "off-balance sheet financing" (operating leases). In this sense, if a company leased a good (and applied the operating lease model), it did not recognize any asset or liability (apart from the expense accrual), while if a company purchased the same good using a loan, it recorded the underlying asset and the debt, leading to very different financial statements. Both operations may be similar from an economic pint of view, but under IAS 17 (and US GAAP Topic 840) they were recorded differently (IASB, 2016).

As has already been shown in numerous articles and studies (and as experienced by the vast majority of companies applying IFRS), IFRS 16 implementation will entail (and is currently leading to), on the one hand, a highly significant impact on companies' financial statements and, on the other, the need to introduce important changes in systems and processes (including information, accounting and business processes) (see Morales-Díaz, 2016 and Morales-Díaz and Zamora-Ramírez, 2018b).

Under IFRS 16 / Topic 842 the new lease asset and liability to be recorded by the lessee should be calculated by discounting future lease payments over the lease term. The standard gives two possibilities in relation to the rate to be used for that discounting operation (IFRS 16 paragraph 26)[2]:

- A) "Interest rate implicit in the lease" which is defined as "the rate of interest that causes the present value of (a) the lease payments and (b) the unguaranteed residual value to equal the sum of (i) the fair value of the underlying asset and (ii) any initial direct costs of the lessor" (IFRS 16 Appendix A).

- B) In those cases where the implicit rate "cannot be readily determined", a lessee may use what IFRS 16 calls the "lessee's incremental borrowing rate" (IBR)

> defined as: “the rate of interest that a lessee would have to pay to borrow over a similar term, and with a similar security, the funds necessary to obtain an asset of a similar value to the right-of-use asset in a similar economic environment”.

Many lessees do not possess enough information to be able to obtain the “Interest rate implicit in the lease”, as recognized by the IASB in paragraph BC161 of the standard Basis for Conclusions. This is also pointed to by Deloitte (2018, p.6) and KPMG (2017, p.11). Entities that cannot obtain the “Interest rate implicit in the lease” will need to develop their own IBR for discounting lease operations cash flows.

Currently, there is no research that shows which percentage of companies are using interest rate implicit in the lease in relation to companies that use IBR for discounting future lease payments. Nevertheless, the percentage of companies using IBR is expected to be very high. As an example, in Spanish IBEX 35 companies, all of them use (for all or some leases) the IBR as discount rate[3].

As we will see in section 2, one of the points clarified by the standards (both IFRS 16 and Topic 842) regarding the IBR is that it should consider not only the credit quality of the issuer, but also the fact that that the hypothetical loan (for which the rate is obtained) is guaranteed by the underlying asset. This arises since if the lessee does not comply with its payments (under the lease contract), the lessor has the right to recover the leased asset and, therefore, it does not lose the complete remaining nominal amount. In this sense, the type of underlying asset should also be considered: the higher its estimated value, the higher the recovery rate.

An entity may use the yield of an unsecured loan or bond as the first step in estimating the IBR (IFRS, 2019, p.6). Nevertheless, said yield should be adjusted in order to reflect the correct recovery rate associated with the underlying asset. According to the IFRS Interpretations Committee, “in determining its incremental borrowing rate, the Board explained in paragraph BC162 that, depending on the nature of the underlying asset and the terms and conditions of the lease, a lessee may be able to refer to a rate that is readily observable as a starting point. A lessee would then adjust such an observable rate as is needed to determine its incremental borrowing rate as defined in IFRS 16” (IFRIC[4], 2019).

The initial yield (as regards said first stage) may be easily obtained if the company maintains quoted bonds or has recently obtained a loan with a maturity similar to the lease contract term. In other cases, it could be obtained from the yield of bonds issued by peer companies (companies with same rating (credit quality) and same sector, country, etc.).

One important input that should be available in order to be able to use peer information is the credit quality of the lessee. The lessee may have official rating issued by a rating agency. Otherwise, internal models could be used in order to estimate the credit quality. We can find finance literature that present models for obtaining the credit quality of a non-rated company. One of the first proposed models was the one developed by Altman (1968). This model used several basic financial ratios for predicting a counterparty’s default. Other models for estimating credit risk or default probability are the ones developed by Merton (1974), Kaplan and Urwitz (1979), Ederington (1985), Longstaff and Schwartz (1995), Duffee (1999), and Kamstra et al. (2001).

Other authors propose a model for directly estimating the credit rating of a counterparty (using the scale of the ratings issued by the official agencies). Recent papers in this area include those by Creal et al. (2014), Tsay and Zhu (2017), Jiang (2018) and Delgado-Vaquero and Morales-Díaz (2018). This rating represents the first step in obtaining the yield of an unsecured loan or bond.

As previously mentioned, the second step (once the standard yield is obtained) would consist of adjusting the initial yield in order to consider the correct Loss Given Default (LGD)[5]. There is wide coverage in the existing literature as regards the LGD to be used in measuring the loan loss provisioning or for estimating the Credit/Debit Value Adjustment (CVA/DVA) in derivatives valuation (Bastos, 2010, Qi and Zhao, 2011, Yashkir and Yashkir, 2013), and even lease operations (Hartmann-Wendels et al., 2014 and Miller and Töws, 2018). Nevertheless, there are no examples of literature that proposes a model linking the LGD with the yield to be used (the IBR).

In short, there is no single model that meets all of the following characteristics:

- Able to estimate how the yield/interest rate can be modified in order to reflect a specific LGD, once the corresponding standard yield/interest rate and the LGD are obtained.

- A simple model able to be used by all kinds of companies currently implementing IFRS 16.

- Uses updated market data (and not historical data) as the principal input.

Furthermore, the development of a model is also necessary since quoted products do not exist in markets that are linked to various recovery rates associated with the different underlying assets backing a leasing contract.

Considering this context, we will propose a model that meets all of the aforementioned requirements. In other words, the objective of our paper is to develop a model that is able to introduce an adjustment to the standard IBR (obtained from unsecured bonds / loans) in order to adapt that IBR to the different recovery rates associated with the leased assets. We will assume that:

- The entity already has a standard IBR, which is the starting point of our model (nevertheless, in section 2.7 we include a brief summary of how to obtain this standard IBR).

- The entity is able to estimate the recovery rates associated with the leased assets (nevertheless, in section 3.1 we include several possible sources of information for obtaining standard recovery rates).

Other authors have proposed solutions for estimating a discount rate but referred to other standards and other issues. Husmann and Schmidt (2008) provide a guidance in relation to the discount factor for impairment calculation under IAS 36. Schauten et al. (2010), try to determine the discount rate of the intangible assets.

It is worth noting that the model we will present is also applicable in many other contexts. For example, for estimating the fair value of a loan / bond that includes an asset as a collateral (for accounting, trading or other purposes): the model can be used for adjusting the discount curve and correctly reflect the higher (or lower) recovery rate. Another example could be the calculation of the interest rate of a collateralized loan transaction between a lender and a borrower: the model can be used for adjusting the standard interest rate to the collateral value.

It should also be noted that, as mentioned before, IBR is one of the two possibilities that IFRS 16 offers as a discount rate (together to the lease implicit rate). If lease implicit rate is applied by the entity, the model that we will present is not applicable, as the implicit rate already includes all risk components and should not be further adjusted (IFRS 16, paragraph BC161).

The rest of the paper is structured as follows: in the following section (section 2), we will develop the main characteristics that the IBR should include according to IFRS 16.

In Section 3, we will provide a step-by-step explanation of the model, including its theoretical basis. Finally, in Section 4, we will provide the final conclusions.

2. Incremental Borrowing Rate

2.1 IBR as a hypothetical loan rate

As stated in previous section, in order to calculate the initial value of the lease asset and liability under IFRS 16, lessees must discount future lease payments over the lease term. The discount rate to be used should be the "interest rate implicit in the lease", but in many cases it will be the "lessee's incremental borrowing rate" (IBR) defined by IFRS 16 as: "the rate of interest that a lessee would have to pay to borrow over a similar term, and with a similar security, the funds necessary to obtain an asset of a similar value to the right-of-use asset in a similar economic environment".

The IBR would be the interest rate (or more precisely, the yield-to-maturity) of a hypothetical loan that the entity would have obtained for purchasing the underlying asset, considering aspects such as the lease maturity, the credit quality of the lessee (which would be the loan issuer), or the fact that the loan would have had the leased asset as collateral or guarantee.

It should be noted that the IBR level influences the effect of the new standard as it determines the magnitude of the lease asset and liability to be recognised. The effect of the discount rate in the capitalisation model (the IFRS 16 model for lessees) is shown in Table 1.

[*Insert Table 1 here*]

Mathematically speaking, the higher the IBR, the lower the present value of the lease asset (right-of-use) and lease liability. A higher IBR means less depreciation charge (since the amount of the asset to depreciate is lower), higher interest expense (since the interest rate is higher), which will result therefore in a more significantly decreasing expense structure (since the depreciation charge is generally linear while the interest expense decreases over time).

IFRS 16 states that the lessee's incremental borrowing rate (the IBR) should consider all of the following aspects (IFRS 16 paragraph BC161):

- Moment in time in which the rate is obtained/used (see section 2.2)
- The maturity of the lease (see section 2.3)
- The economic environment/currency in which the transaction occurs (see section 2.4)
- The credit quality of the lessee (see section 2.5)
- The nature and quality of the collateral (generally the leased asset) (see section 2.6)

2.2 Moment in time

The level of interest rates (both the risk-free rate and the corresponding credit spread) vary over time depending on various factors: supply and demand, central banks' monetary policy, changes in the issuer's credit risk (credit spread), etc.

For this reason, it would not be appropriate to calculate a single interest rate curve, for example at IFRS 16 first implementation date, and maintain it over time for all new leases (or for applicable liability recalculations). The curves must be updated to be applied to any new leases entered into and to liability re-measurements that involve using a new discount rate. The update should consider changes in risk-free interest rates and changes in the applicable credit spread.

In the following figure (Figure 1) we can see, as an example, the performance of the 10Y, 5Y and 3Y Euro swap rates from 2000 until April 2019.

[*Insert Figure 1 here*]

If we take this rate as the "risk free rate" (Hull, 2018, p.81) we can see how this factor contains a high volatility that should be considered when obtaining new rates. Credit spread can also be subject to high volatility (Collin-Dufresn et al. 2001 and Cao et al. 2010). For a company that seldom enters into leases, it may only be necessary to estimate a curve or a rate for each date on which a lease is entered into or for each date on which the lease liability should be re-measured by discounting the new flows with a new rate.

On the other hand, many large groups enter into multiple lease operations on a daily basis. In these cases, at least one discount curve should theoretically be calculated every day. Nevertheless, for operational reasons, many groups will not be able to estimate a curve on a daily basis. In such cases, a practical solution could be used to obtain a discount curve on a monthly (rather than daily) basis. That is, for all leases entered into or whose flows are modified in the same month, the same interest rate curve will be used, assuming that any potential error would be non-material.

Nevertheless, if this proxy is applied, management controls should be implemented in order to detect sudden intra-month interest rate movements that can invalidate the assumption of the abovementioned non-material effect.

2.3 Lease maturity

In the interest rate market, the level of interest rates depends on the term (maturity). Generally, the higher the maturity of the operation, the higher the interest rate. In other words, interest rate curves tend to have a positive slope due to factors such as risk (the longer the term, the higher the risk): in loans and financing (as in leases) the longer the term, the higher the interest rate (assuming other conditions remain unchanged). In long term rates the tendency can change (Cox et al. 1985, Wood, 1983, Cook and Hahn 1990, Brown, 2000, Hull 2018 p.99-101).

In Figure 2 we include Euro Zero Coupon curve as at 10 April 2019 (obtained from interbank rates: deposits and swaps). We can see how the rate is different depending on the maturity (the curve is generally not flat).

[*Insert Figure 2 here*]

Considering this, for the same date, a single interest rate would not be obtained for all leases with different maturities, but rather a discount interest rate curve based on the market data used to obtain it. In other words, considering the same issuer, same currency, same collateral, etc., different yields are applicable depending on the maturity.

2.4 Currency

The "risk free" market interest rate varies depending on the economic environment of the operation (understood as the currency in which the payments are expressed). This is mainly due to supply and demand and to the monetary policies of the different central banks. For example, the risk-free interest rate of the Euro is, in 2020, lower than the US Dollar (USD) due to the European Central Bank's expansionary monetary policy.

Theoretically, interest rate curves will differ depending on the currency in which the payments are denominated (and not the country in which the contract is entered into). This is because, from the lessor's point of view, the comparable alternatives to a lease operation in USD would be other investments in USD. An investment in USD is required to have a return related to the yield of the assets in USD.

In this sense, if a company with the Euro as its functional currency enters into a lease agreement where payments are denominated in USD, the cash flows must be discounted using the USD curve. If, in the same lease, several currencies are defined for making payments, each cash flow would be discounted using the rate that corresponds to its respective currency.

2.5. Lessee's credit risk

Another factor influencing the interest rate level of a financing or leasing transaction is the credit risk of the issuer. The discount rate must include the risk-free rate and the corresponding credit spread. In general, the higher the credit risk, the higher the required return and, therefore, the higher the applicable credit spread.

In some cases, the lessee's credit quality (which is associated with a credit spread) will be easy to obtain as the lessee has issued quoted bonds, or has a public rating issued by a rating agency. Nevertheless, in other cases it will be more difficult, as no such data exists.

In the latter cases, an entity can use information such as:

- Theoretical credit rating obtained by comparing an entity's financial ratios with the ratios of other comparable companies that have a public rating (Delgado-Vaquero and Morales Díaz, 2018).

- Recent financing obtained by the company.

A question arises as to whether a subsidiary can use the credit quality / credit spread of the parent company or the group. In general, the answer to this question is that it cannot. Each individual entity should calculate its own rate depending on its own credit quality (which will depend on factors such as the quality of its assets, sector, business, leverage, etc.). Nevertheless, there may be some cases where it may be able to do so:

- The parent company has issued a guarantee in relation to the payments of the lease. In other words, from a legal perspective, the lease payments are specifically secured by the parent company.

- In the example included in US GAAP Topic 842 paragraphs 842-20-55-17 to 842-20-55-20, the subsidiaries use the debt interest rate of the parent company to obtain the lessee's incremental borrowing rate. However, the example specifies that the subsidiary companies are not rated and do not carry out external treasury operations. That is, they would be financed exclusively through a loan from the parent.

For KPMG (2017, p.22), as a principle, the subsidiary cannot automatically use its parent or group rate in its separate financial statements. However, in some cases it might be reasonable for a subsidiary to use its parent's or group's incremental borrowing rate as an input and would need to adjust it as needed when determining the appropriate discount rate for a lessee. For example, this might be appropriate when the subsidiary does not have its own treasury function, all funding for the group is managed centrally by the parent and this results in the parent providing a guarantee of the lease payments to the lessor. In this case, the pricing of the lease may be more significantly influenced by the credit standing of the parent than that of the subsidiary.

2.6 Underlying asset (collateral)

Finally, the last factor that could influence the discount rate is the guarantee for the lease. The better (or greater) the collateral, the lower the interest rate because the risk is lower.

In lease operations, this results in the recovery of the leased asset in the event of the bankruptcy of the lessee. The greater the residual value of the asset at the time of recovery in relation to the amount of the unpaid instalments (lease liability), the greater the guarantee.

If an entity uses bond yields as a basis for estimating a lessee's incremental borrowing rate, it should consider that bonds are generally unsecured, and that the lease operation is secured by the leased asset. This means that the lease operation may have a higher guarantee that the bond and, therefore, the yield should be lower.

This last factor is the factor related to the objective of our paper. As stated before, the aim of the model that we will present in section 3 is to adjust the general interest curve (the standard IBR) for adapting it to the several expected recovery rates (including those ones lower than standard unsecured bonds'). For example, if we take the standard IBR from bonds, the general expected recovery rate would be 40%. Nevertheless, in the lease operation, the estimated recovery rate could be, for example, 60%. The IBR should be adjusted to reflect this lower risk level.

2.7 General process

A group could implement two possible process for obtaining the lessee's IBR rate for each group company:

- 1) If the company maintains issued bonds that are quoted in a liquid market, the corresponding curve can be constructed using the yield of those bonds. Bond yields include both the risk-free rate and credit spread. These rates can be used as a starting point. Other rates that can be used are:
    - Rates of recently obtained loans.
    - Property yields. According to EY (2020, Chapter 23 Section 4.6), observable rates, such as property yields can be used as a starting point but adjustments need to be considered for the specific right-of-use asset. Credit risk adjustment may also be made to these rates as the payer would be different.

When using bond rates as a basis, it should be noted that, generally, bonds are marketable securities (often with a high liquidity) and leases are not transferable. This means that a liquidity spread should be added to bond yields. In other words, the yield of a lease is expected to be higher than that of a bond yield due to this fact (assuming all other aspects are similar: credit spread, collateral, maturity, etc.).

- 2) Another possibility is using swaps rates as a starting point and adding a credit spread obtained from CDSs or bonds.

Otherwise, if the entity does not have quoted bonds or CDSs it can obtain a theoretical credit rating and use that information from peers (Delgado-Vaquero and Morales-Díaz, 2018).

Once the standard curve has been obtained, the curve is modified in order to include the recovery rate for the underlying asset. The models' rationale relies on the fact that the standard senior, uncollateralized, yield curve for the lessee is the most liquid asset on its credit risk. Therefore, as we will see in the following section, the standard curve (the standard IBR) would be the pivotal ground from which the models build a curve adapted to the underlying asset.

3. Model proposal and theoretical basis

3.1 Introduction

The proposed methodology is developed in the framework of default risk pricing and the relationship between default probability, recovery rates and credit spreads.

The overall goal is to have a model that allow adjusting an existing standard yield curve for obtaining a new curve that implicitly reflects the expected recovery rate of the underlying collateral. This is, we need modeling a yield curve adapted to the expected recovery for the collateral in such a way that higher recovery rates will entail lower yield-to-maturity curves and vice-versa.

Thus, as previously stated, there exist two main concerns to deal with in this framework. Firstly, the need of selecting an appropriate standard discounting curve for the lessee. This entails that the lessee is expected to have a consistent yield-to-maturity curve. The lessee might have issued debt or bonds from which a yield curve can be constructed. Otherwise, additional analyses should be done to calibrate a curve that can be associated to the rating and sector of the lessee under a standard seniority (usually, senior unsecured debt). See, for instance, Delgado-Vaquero and Morales-Díaz (2018) for proposed models in this regard.

The recovery information (the recovery rate) is the other critical aspect to be analyzed. Usually, market information about recovery rates can be easily obtained in relation to the main sectors, covering historical data on LGDs. This information is usually provided by the main rating agencies (Moody's, Standard and Poor's and Fitch's). As an example, below (see Table 2) we include the information provided on the recovery rates (LGD) by Moody's (2018) for corporate debt measured by trading prices, split into priority position (from 1st lien bank loans to junior, unsecured and subordinated securities).

[*Insert Table 2 here*]

Most quoted debt instruments (and their linked standard yield curves) are senior unsecured bonds, with a standard recovery rate of approximately 40%, according to historical performance, adopted to price standard credit-linked instruments (bonds, CDS and other credit derivatives) by market conventions.

This previous background will serve as the basis for the model. As one can guess, leasing collaterals generally have a different recovery rate (different than 40%), given their particular nature, usage and expected amortization. Table 3 summarizes the results of one of the most updated studies in this regard (Hartmann-Wendels et al., 2014).

[*Insert Table 3 here*]

Nevertheless, as stated before, there are no quoted products in markets that are linked to the several recovery rates associated to the different, plausible underlying assets backing a lease contract. Hence, the methodology that we propose try to cover this issue. In this context we need a model framework that deals with the main risk factors involved, namely: yield-to-maturities, credit ratings, recovery rates, credit spreads, default probabilities and updated market information.

3.2 Model hypotheses and assumptions

As previously outlined, it is difficult to find traded products that provide a wide range of implied recovery rates. Therefore, our proposal is to use traded products whose price directly depends on credit spreads and recovery rates, and that will allow us to calibrate spreads from different recovery rates (depending on the collateral backing the leasing contract).

The model hypotheses and assumptions are as follows:

- Credit-linked traded products will be used to analyze how their prices (in terms of credit spread) change when recovery rates change, assuming a deterministic, static default probability curve for any recovery rate / product tranche seniority.

- The model presented assumes that the lessee is a company (a legal entity), with public financial information for which a corporate rating can be estimated. Hence, this framework does not apply to an individual as a lessee.

- Physical delivery is expected for the instruments used in the methodology. This means that the CDS used in the model (see Section 3.3) are assumed as the only instruments that have the bonds as underlying.

- Seniority and collateral type are the most important determinants of recovery rates at default: higher seniority/better collateral higher recovery at default. In the models that we will present, standard recoveries are rounding 40% as the bonds to be used for computation are usually senior unsecured bonds.

- Neither long-term averages nor moving averages of loss-given default are predictors of current losses-given default per se. This is caused by the cyclical nature of LGD. Therefore, LGDs and subsequently, recovery rates can vary for the same product/seniority/collateral depending on the state of the economy. This include also geographical issues. Therefore, the LGDs assumed for a given issuer/issuance may vary throughout time.

- Secured debt is less sensitive to the default risk and to the general state of the economy than unsecured debt. This applies to most of asset classes, and this is the pivotal point of the models to be introduced. Namely, issuances with more liquid collaterals behind them are expected to have Recovery Rates higher than the ones with less liquid collaterals.

- Fixed income and credit markets are assumed as the most reliable sources of information, including updates in every risk factor to be used. The relationship between LGDs, YTMs and default risk is understood through market instruments.

- The model does not cover lease contract liquidity and sovereign risk.

3.3 Model Proposal: CDS spread sensitivity to Recovery Rate

In the proposed model, we analyze the sensitivity of a credit-linked instrument in relation to the recovery rate. We will use Credit Default Swaps (CDS) prices, the default probability embedded in a CDS price and the CDS spread sensitivity to changes in the expected recovery rate.

In this context, we firstly need to understand the model framework for standard CDSs.

A standard CDS is a contract in which one counterparty (the protection buyer) pays a regular fee (the CDS spread) and the other counterparty (the protection seller) must pay a default payment if a credit event occurs with respect to a reference entity. The default payment is designed to approximate the loss that a holder of a bond issued by the reference entity would suffer at the default event. Therefore, we need to give a probability of occurrence to this event with a certain distribution function.

Default event models, as many other models used to infer occurrence probability, might be understood to follow an intensity-based process *N*: an event probability with an occurrence rate λ for a time period $T - t = \Delta t$. Namely,

$$P[\mathrm{N}(t + \Delta t) - \mathrm{N}(t) = 1] = \lambda \Delta \mathrm{t} \tag{1}$$

so that

$$P[\mathrm{N}(t + \Delta t) - \mathrm{N}(t) = 0] = 1 - \lambda \Delta \mathrm{t} \tag{2}$$

We can subdivide the interval [*t*, *T*] into *n* subintervals of length $\Delta \mathrm{t} = (T - t)/n$. In each of these subintervals the process *N* has a jump with probability $\lambda\Delta$t. If we conduct *n* independent binomial experiments each with a probability of $\lambda\Delta$t for a "jump" outcome, the probability of *no* jump at all in [*t*, *T*] is given by

$$P[\mathrm{N}(T) = \mathrm{N}(t)] = (1 - \lambda \Delta \mathrm{t})^n = \left(1 - \frac{1}{n}\lambda(T - t)\right)^n \tag{3}$$

As $\left(1 - \frac{x}{n}\right)^n \rightarrow e^x$ if $n \rightarrow \infty$, this converges to a Poisson process with no event between each subinterval *n*:

$$P[\mathrm{N}(T) = \mathrm{N}(t)] = e^{(-\lambda(T-t))} \tag{4}$$

Translated into default probabilities, and considering different occurrence (hazard) rates λ_n for different predefined time intervals [T_{n-m}; T_n] of the instrument life, the instrument survival probability between *t* and *t* + Δ*t* is:

$$SP[t, t + \Delta t] = e^{(-\lambda_i \Delta t)} \tag{5}$$

And therefore, the cumulative PD in the same context will be:

$$PD[t, t + \Delta t] = 1 - e^{(-\lambda_i \Delta t)} = 1 - SP[t, t + \Delta t] \tag{6}$$

If we assume that there exist different hazard rates for different time intervals, as per (5), we will have a discretized distribution of hazard rates for each time interval:

$$Hazard\ rate\ for\ each\ time\ interval\ \Delta t_i = \begin{cases} \lambda_1, & \Delta t \in [0, t_1) \\ \lambda_2, & \Delta t \in [t_1, t_2) \\ \lambda_3, & \Delta t \in [t_2, t_3) \\ \vdots & \vdots \\ \lambda_T, & \Delta t \in [t_{i-1}, t_T) \end{cases} \tag{7}$$

from which we have the Survival Probability Curve (*SPC*), that is the cumulative survival rate to be used in the CDS pricing framework:

$$\begin{matrix} Survival\ Probability\ Curve \\ for\ each\ time\ horizon\ T = \end{matrix} \begin{cases} SP[0, t_1) = e^{-\lambda_1 \Delta t_1}, & T \in [0, t_1) \\ SP[0, t_2) = e^{-\lambda_1 \Delta t_1 - \lambda_2 \Delta t_2}, & T \in [0, t_2) \\ SP[0, t_3) = e^{-\lambda_1 \Delta t_1 - \lambda_2 \Delta t_2 - \lambda_3 \Delta t_3}, & T \in [0, t_3) \\ \vdots \quad \vdots & \\ SP[0, t_T) = e^{-\lambda_1 \Delta t_1 - \lambda_2 \Delta t_2 - \lambda_3 \Delta t_3 \cdots - \lambda_{i-1} \Delta t_{i-1} - \lambda_T \Delta t_T}, & T \in [0, t_T) \end{cases} \tag{8}$$

where Δt_i is the time interval for each λ_i.

Returning to the CDS note pricing, the protection buyer pays the CDS spread as an insurance fee to hedge the potential default of a reference entity. Therefore, this implies that the protection buyer pays the CDS related to that reference entity, on a predefined period of time. The present value of the protection "leg", assuming that the potential default events occur between each two payment moments, is estimated as follows, following (8):

$$\begin{aligned} Prot.Leg &= N \cdot Spread \cdot \\ &\cdot \Delta t \sum_{i=1}^{T} SP[0, t_i]\, P(0, t_i) + \frac{1}{2}\left[SP[0, t_{i-1}] - SP[0, t_i]\right] P(0, {t_{i-1} + t_i}/_{2}) \end{aligned} \tag{9}$$

where N is the contract notional, $Spread$ is the spread of the CDS for the predefined period of time (maturity) i, $SP[0, t_i]$ is the cumulative survival probability at each payment time, with the particularity that each payment time will have different hazard rates. This is, the CDS is to be modeled with as many different hazard rates as payment nodes it has. This implies that de survival probability curve gains convexity and adapts each payment interval to the expected default probability that exists within.

On the other hand, the default leg is expected to be

$$Default\ leg = N\,(1 - R) \sum_{i=1}^{T} \left[SP[0, t_{i-1}] - SP[0, t_i]\right] P(0, {t_{i-1} + t_i}/_{2}) \tag{10}$$

with $SP[0, t_{i-1}] - SP[0, t_i]$ to be the conditional probability in the CDS life-time filtration that the default time of the entity underlying the CDS occurs at the mid of the interval

$(t_{i-1}, t_i]$ (given survival until t_{i-1}), and R is the recovery rate, assumed constant for the entire CDS extension.

Therefore, the CDS price at any point in time will be the difference between the two legs (from the protection buyer point of view):

$$CDS\ price = Default\ leg - Protection\ leg \qquad (11)$$

The CDS is usually priced at par at inception, what means that:

$$Default\ leg = Protection\ leg \quad if\ \ t = 0 \qquad (12)$$

with a spread that makes the protection leg equal to the default leg. Hence, if we solve for the equilibrium spread, leaving out of this scope the notional, the above equation turns into the following:

$$Spread = (1 - R)\frac{\sum_{i=1}^{T}[SP[0, t_{i-1}] - SP[0, t_i]]\, P(0, {}^{t_{i-1} + t_i}/_2)}{\Delta t \sum_{i=1}^{T} SP[0, t_i]\, P(0, t_i) + \frac{1}{2}\, [SP[0, t_{i-1}] - SP[0, t_i]]\, P(0, {}^{t_{i-1} + t_i}/_2)} \qquad (13)$$

The term in the numerator is the cumulated probability of default for the CDS life extension, whereas the term in the denominator is the cumulated survival probability, which also may be understood as the CDS price sensitivity to a bp (basis point) of spread, $Sp01$:

$$Spread = (1 - R)\frac{Cumulated\ PD}{Sp01} \qquad (14)$$

Assuming that we already know the underlying bond recovery rate R, the next step in this method will be calibrating the different hazard rates. This process will entail that each λ_i will be calibrated starting from a standard initial period, for instance 6 months, in such a way that the Survival Probability nodes are being defined from the earliest to the latest, arriving to the equality shown in the equation above.

With this framework, the sensitivity of the spread to the Recovery Rate is relatively easy to analyze. The basis will also consist in finding fixed vanilla bonds issued by entities similar to the lessee in terms of rating, currency and sector. However, we also need to find CDSs similar in same context.

Bonds and CDSs used for the analysis need to be unquestionably linked, because the CDSs spread will determine the market YTM. If we find a liquid, vanilla bond for which a quoted CDS curve exists (or at least, a CDS curve on its rating and sector), we can then price the bond price with accuracy by using the formula below:

$$Bond\ price = \sum_{i=1}^{n} CF_i \frac{1}{(1 + rf_i + sp_i)^i} \qquad (15)$$

where rf_i is the risk-free rate and sp_i is the market CDS spread at each cash-flow CF_i payment date i. Hence, if a senior unsecured vanilla bond has a market price *x*, this price can be accurately replicated by using an adequate risk-free curve and a related CDS spread curve in terms of sector, rating and currency. The CDS spread represents, in terms of credit risk, the premium over the risk-free rate required by the market to buy the underlying bond. Therefore, the CDS spread can be understood as the portion of yield with idiosyncratic credit risk, so that one can guess why this spread should be added to the risk-free rate to price the underlying bond, as it is the premium paid off in the CDS trade because of the default probability.

The previous assumption comes from the fact that a CDS is designed such that a combined position of a CDS with a defaultable bond issued by a counterparty is very well hedged against default risk, and should therefore trade close to the price of an equivalent default-free bond. This means that the sum of the CDS and the risk-free bond should be equal to the defaultable bond price.

Below we analyze how the bond price changes and, subsequently, the change in YTM, once the recovery rate changes at the same time.

As an example, imagine that our lessee is a company placed in the transportation and logistics sector, and it needs to arrange a leasing contract maturing in 4y with technical electric equipment as a collateral, with an average expected recovery rate rounding 33%, following the information from table 3. The rating of the company is BBB, and it does not have liquid debt instruments quoted in the market, so that we should find comparable peers with liquid bonds and credit default swaps.

The Reuters EUR BBB Transportation CDS curve reference and its risk factors are as follows, as of 23/05/2019 (Reuters code *0#BBBTRACDBMK=*):

[*Insert Table 4 here*]

The bond market gives, for this rating, sector and currency, the following YTM curve (Reuters code *0#BBBEURTRABMK=*):

[*Insert Figure 3 here*]

We know that the bonds constituting the 4y tenor have the following features as of valuation date: average market price of approximately 106.63%, an average YTM of 0.69% and an average maturity date 20/05/2023, with an annual coupon of 2.35%. With this structure, we firstly replicate the price by using the BBB Transportation CDS curve quoted by Reuters (Table 5) and the Euribor 12M zero coupon curve, in turn to check that the CDS curve to be used fits to the expected pricing:

[*Insert Table 5 here*]

As expected, the convergence between the market price and the price derived from using the CDS spreads is quantitative enough for modeling purposes. This only happens if the CDS curve is representative enough in terms of rating, sector and geography, concerning the bonds used to calibrate the yield curve. There is a discrepancy of 12 bps in price, but one should note that the constituents of the Reuters CDS curve are not the same as the ones constituting the yield curve, apart from other slight differences in market conventions.

Once checked this convergence, the next step is to measure the sensitivity in the bond price to the recovery rate. For this, we need firstly to measure the expected change in the credit spreads from a change in the recovery rate. Hence, upon equation 12, the change in the recovery rate from 38.93% to 33% entails the following increase in the credit spread curve:

[*Insert Table 6 here*]

This means that the bond price changes from 106.75 to 106.47. Translated into YTM change, recalling (4), the price 106.75 meant a YTM of approx. 0.66%. However, the new Price (106.47) leads to a new 4Y YTM of 0.7304% (a ΔYTM = +7 bps).

This process, as in the first method, should be carried out for the representative maturities in the yield curve. It is crystal clear the necessary similarity between the bonds compounding the yield curve and the CDSs used for the bond pricing regarding rating and sector.

As a result, the new curve is to be as the following:

[*Insert Figure 4 here*]

The adjusted curve is higher due to the fact that the lower recovery rate should be compensated via an increase in the return for the lessor.

Some assumptions for this framework on the CDS valuation should be considered:

- As commented above, a CDS is designed as a combined position of a CDS with a defaultable bond issued by a counterparty.

- Also, in turn to ease the computations, we assume that each payoff occurs at the time of each default.

- We ignore the delivery option which is embedded in a CDS with physical delivery. We consider that CDSs hedge the corresponding defaultable bonds, so that the same recovery rates are intrinsic for the bonds and the hedging CDS. Otherwise, there could not be the necessary matching between yield and corresponding CDS curves under sector and rating.

- We assume that the CDS is triggered an individual obligors' default (although the obligor is a basket under our model, we are considering it as a whole, for a sector/rating CDS curve treatment).

3.4 Comments and limitations within the model

There exist two main limitations on the model. The first one is related to the liquidity risk attached to any leasing contract. This is, quoted debt is much more liquid than a leasing contract. A bond holder can sell the bonds under certain clauses in a relatively liquid market where the yield bid-ask spread can vary but the price is formally set. However, in the case of a leasing contract, the lessor, who is financing the lessee on a given timeframe, has no actual information on its asset price (the leasing contract) nor certainty on the collateral recovery (if a default event takes place). Also, the collateral value is expected to decrease over time, in terms of amortization and use effects. Because of this, an additional liquidity spread might be added to both standard and adjusted curves, which depends on the collateral nature, the contract extension and the collateral expected degree-of-use.

The second main limitation is the plausible liquidity squeeze in the bond prices or the lack of bonds/CDSs for several maturities, sector, rating or even currency. For several sectors, and also regarding non-investment grade ratings, the information on bond prices or YTMs is not always as liquid as desirable. The bid-ask spreads use to be quite wide, and there are no many tenors quoted for representative curves on Bloomberg or Reuters. Also, this applies to CDS indices, for which non-investment grade ratings are represented by very few sectors. Therefore, some assumptions should be done in this regard: extrapolation of CDS spread change from investment grades to non-investment grades; extrapolation of rating curves from liquid sectors to sectors without enough information; extrapolation of the curve slope from short and medium-term tenor to longer tenors for which there is no quoted bond/CDS information, etc.

4. Conclusions

IFRS 16 is the new lease standard that is been applied from year 2019 (the US GAAP equivalent is Topic 842).

These standards introduce a capitalization model to be applied by the lessee for the majority of lease transactions. The model implies calculating the initial value of a lease asset (called right-of-use) and a lease liability by discounting lease payments over the lease term. Subsequently, lease asset is subject to depreciation and impairment and lease liability is basically recognised as a financial liability at amortised cost.

Generally, entities are using what the standards call Incremental Borrowing Rate (IBR) for discounting future lease payments. One of the factors that the IBR should consider is the collateral that the leased asset represents for the lessor. In case the lessee defaults, the lessor repossesses the leased asset and have the possibility of selling the asset or leasing the asset to a different counterparty so that it does recover at least a part of the hypothetical loan.

Assuming that the initial curve is obtained from unsecured bonds or CDS spreads, an adjustment should be introduced to consider the quality of the collateral (i.e. to consider a recovery rate different from the general recovery rate). We propose a model which adapts the standard market curves to the different leased assets depending on their assumed recovery rate.

The model is based on analysing the percentage change on the CDS spreads assumed for the lessee when the recovery rate changes. It can be easily implemented by entities that needs to maintain several discounting curves depending on the leased asset. The model uses quoted CDS market information as the main reliable source, and is based on standard valuation models. This way, the outcomes are aligned to market standards and quoted information, which is the grounding to estimate Fair Values beyond vanilla securities.

The model has also some considerations and limitations that should be taken into account. The model is built upon the availability of credit market information, which sometimes cannot be enough for certain type of issuers or sectors. One possibility is to take CDS quotes from peer companies.

Also, one should consider the fact that the estimated recovery rates for a given collateral or security may change over time. This means that the models' inputs should be revisited and recalibrated frequently. Moreover, it should be noted that there exist several risk factors not entirely covered by the model (e.g. sovereign risk, currency risk) so that the reference data and the market information chosen might content factors that could distort the outcome. Therefore, the relevancy of using market data and securities as much similar as possible to the leasing contract under analysis is a crucial matter.

Finally, and as introduced in Section 1, it should be highlighted that the model proposed have many applications for accounting and non-accounting purposes. It can be used, for example, for estimating the fair value of a loan / bond that includes an asset as a collateral (for accounting, trading or other purposes): the model can be used for adjusting an standard discount curve and correctly reflect the higher (or lower) recovery rate.

Notes

[1] Short term leases and leases of low value assets. IFRS 16 paragraph 5.

[2] It should be noted that, under IAS 17, lessees had also these two possible rates for obtaining the "present value of minimum lease payments" in finance leases (see paragraph 20). Therefore, the incremental borrowing rate is not a new concept introduces by IFRS 16. The difference is that under IAS 17 it was only applicable for finance lease and under IFRS 16 is applicable to all leases.

[3] Information obtained from their 2019 financial statements.

[4] IFRIC: IFRS Interpretations Committee

[5] LGD = 1 – *R*, being *R* the Recovery Rate.

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Table 1. Effect of the discount rate level on lessee financial statements.

Discount rate level	↑	↓
Initial value of the right-of-use (lease asset)	↓	↑
Initial value of the lase liability	↓	↑
Interest expense	↑	↓
Depreciation charge	↓	↑
Total expense structure over the lease life	+ decreasing	- decreasing

Source: compiled by the authors.

Table 2. Average corporate debt recovery rates measured by trading prices

Priority Position	Issuer-weighted recoveries		
	2017	2016	1983-2017
1st Lien Bank Loan	69.04%	75.05%	67.07%
2nd Lien Bank Loan	17.87%	22.50%	30.38%
Sr. Unsecured Bank Loan	9.00%	N/A	45.87%
1st Lien Bond	62.43%	48.72%	53.62%
2nd Lien Bond	52.75%	34.07%	45.18%
Sr. Unsecured Bond	53.85%	31.45%	37.74%
Sr. Subordinated Bond	38.00%	36.72%	31.10%
Subordinated Bond	74.38%	24.50%	32.05%
Jr. Subordinated Bond	17.50%	0.63%	22.79%

Source: Moody's (2018).

Table 3. Estimated recovery rates for lease contracts.

Leased asset	Recovery rate
Vehicles	60.47%
Machinery	50.91%
ICT	11.79%
Equipment	33.96%
Other	53.98%
Real Estate	80.00%

Source: Hartmann-Wendels et al. (2014) and Ou et al. (2013).

Table 4. EUR BBB Transportation sector CDS index curve.

		Bid Spread (bps)	Default Prob. (%)	Sp01	Recovery Rate (%)
6M	23/11/2019	15.83	0.15	578.80	38.93
12M	23/05/2020	19.26	0.34	1078.10	38.93
2Y	23/05/2021	32.62	1.10	2059.40	38.93
3Y	23/05/2022	47.97	2.37	3017.20	38.93
4Y	23/05/2023	69.22	4.47	3943.50	38.93
5Y	23/05/2024	90.25	7.14	4831.47	38.93
7Y	23/05/2026	121.21	12.84	6469.10	38.93
10Y	23/05/2029	145.43	20.62	8659.07	38.93

Source: Reuters and compiled by the authors.

Table 5. EUR BBB Transportation sector 4Y Maturing bond pricing.

		23/05/2019	23/05/2020	23/05/2021	23/05/2022	23/05/2023
Coupon	2.35%		2.393%	2.386%	2.386%	102.386%
Discount Factor	$\frac{1}{(1+rf_i+sp_i)^i}$		99.824%	99.658%	98.880%	97.310%
					Market price	106.63%
					Price using CDS spread	106.75%

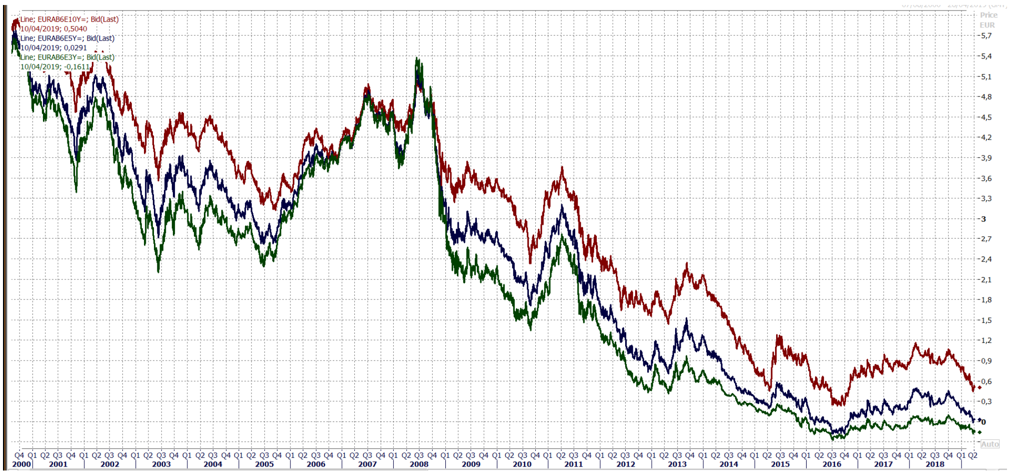
Source: Reuters and compiled by the authors.

Table 6. BBB Transportation CDS curve adjusted with a Recovery Rate = 33%.

	New Mid Spread with RR = 33% (bps)	Change (bps)
6M	17.39	1.56
12M	21.19	1.93
2Y	35.97	3.35
3Y	52.95	4.98
4Y	76.35	7.13
5Y	99.25	9.00
7Y	131.74	10.53
10Y	153.09	7.66

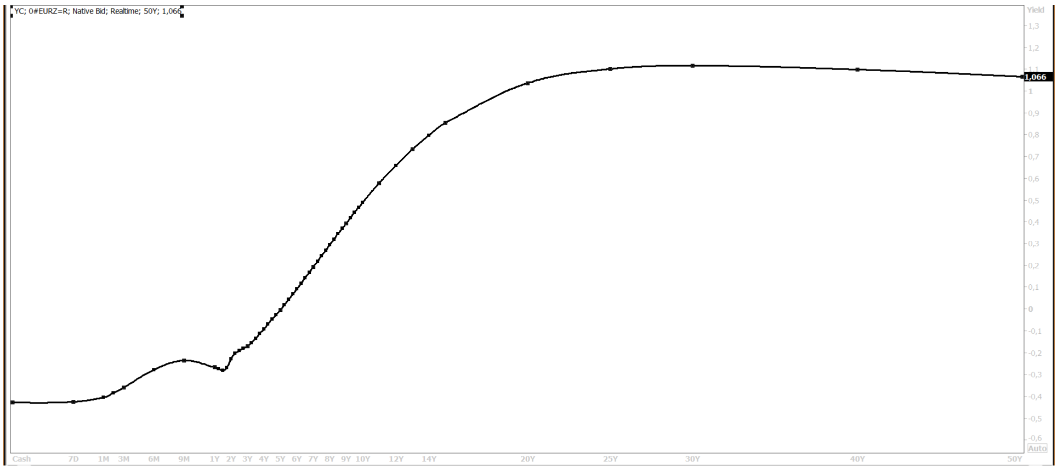
Source: compiled by the authors.

Figure 1. Euro swap rate performance (3, 5 and 10 years).



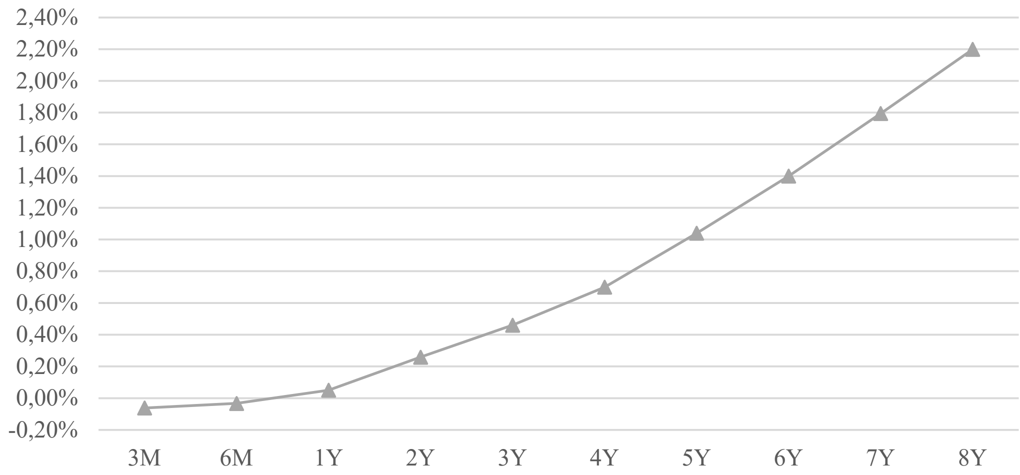
Source: Reuters.

Figure 2. Zero Coupon Curve (Euro – 10th April 2019).



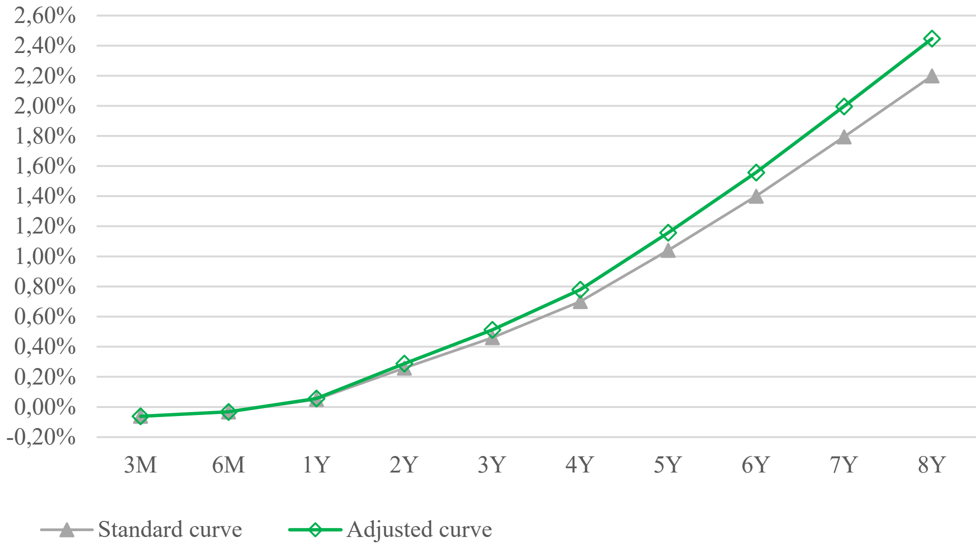
Source: Reuters.

Figure 3. EUR BBB Transportation sector YTM curve, (date: May 3th, 2019).



Source: Reuters and compiled by the authors.

Figure 4. EUR BBB Transportation sector standard and adjusted YTM curves (%), (date: May 3th, 2019).



Source: Reuters and compiled by the authors.