## Financial stability

# Leveraged loans, CLOs – trends and risks

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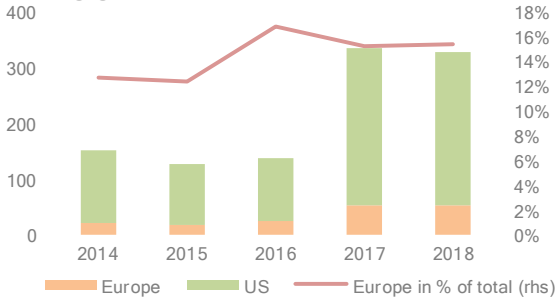
Recent years have seen a significant pickup in the issuance of leveraged loans and collateralised loan obligations (CLOs) in the US and the EU. The surge in issuance occurred against a backdrop of looser underwriting standards, higher indebtedness of borrowers and compressed credit spreads. This article provides an overview of the leveraged loans and CLO markets in the EU. In particular, we assess exposures of the EU fund industry to leveraged loans and CLOs, which remain limited at the current juncture. In addition, the article uses a simulation analysis to show how model uncertainty can impact the credit ratings of CLOs, and potentially trigger forced sales from some types of investors.

## Introduction

### Overview of the leveraged loan market

Recent years have seen a strong pickup in issuance of leveraged loans (V.1) and a compression of credit spreads, in a context of buoyant risk appetite from investors. Estimates of the size of the global leveraged loan market range from USD 1,350bn as of 1Q19 according to J.P. Morgan (against USD 983bn in 2016) to around USD 2,200bn according to the Bank of England (Bank of England, 2018). US loans account for 85% of the global leveraged loan market.[84]

V.1
Leveraged loans issuance
**Strong growth**

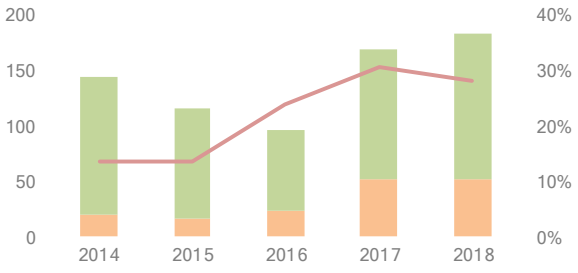



Note: Leveraged loan issuance, in USD bn and in % of total issuance, rhs.
Sources: JPMorgan, ESMA.

In addition, leveraged loans markets have been supported by increased activity through CLOs. Indeed, CLOs have also experienced significant growth in issuance, especially over the last two years, in a context of compressed spreads (V.2). The global CLO market is estimated to amount to around USD 740bn globally, which implies that CLOs hold around 50% of the global leveraged loan market according to J.P. Morgan.

CLOs are securitisation products issued by a CLO structure. On the asset side, the structure holds leveraged loans, which are funded, on the liability side, by the issuance of tranches with different degrees of seniority, the highest tranches enjoying high credit ratings.

V.2
CLO issuance
**Increase in euro CLOs**




Note: CLO issuance, in USD bn and in % of total issuance, rhs.
Sources: JPMorgan, ESMA.

### Drivers of leveraged loans and CLO issuance

In a context of low interest rates, investors have supported leveraged loan issuance as these

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[84] Leveraged loans are loans to highly indebted firms, where the total debt to earnings ratio before interest, tax, depreciation and amortisation (EBITDA) is higher than 4x, and the borrowing firm is not an investment grade borrower (ECB, 2017). Leveraged loans are usually secured loans and are senior to bonds in case of default of the borrower.

instruments offer higher yields than investment-grade corporate bonds. Reflective of the strong investor demand, underwriting standards have loosened (IMF, 2018b), enabling corporate leverage to increase in the US and in the EU (ECB, 2018). Overall, the leverage of leveraged loan borrowers (measured by total debt to EBITDA) is slightly higher in the EU than in the US (at respectively 5.6 and 5.3).

Regarding looser underwriting standards, the share of covenant-lite loans – loans where investors do not require borrowers to be subject to financial maintenance tests to measure their debt service capacity – increased recently in both the US and the EU, accounting for around 87% of leveraged loan issuance in 2018, against 72% in 2016 (J.P. Morgan, 2019a).

### Leveraged loans and CLOs for issuers and investors

Leveraged loans and CLOs may provide benefits to both issuers and investors. For issuers, leveraged loans allow corporates to diversify their funding sources beyond bank loans or bond issuance, thereby facilitating credit to the real economy. For investors, leveraged loans and CLOs can offer attractive returns, with low interest rate risk as those financial instruments are typically floating-rate. The risk-return features of leveraged loans can also improve the performance of a diversified portfolio, since leveraged loans tend to have a low correlation with bond indices (Armstrong and Turulja, 2015). In addition, in the case of CLOs, the issuance of different tranches with varying degrees of credit risk can cater to a diversified investor base, with banks, insurance companies and pension funds acquiring the highest-rated tranches, and asset managers and hedge funds focusing on the riskier tranches offering higher yields.

From a financial stability perspective, investment funds holding leveraged loans and CLOs might reduce risks, as funds exposures are diversified, and fund investors are highly heterogeneous.

## A closer look at investors' exposures

### Overview of exposures and data gaps

Regarding leveraged loans, the Bank of England estimates that around 40% are held by banks, 46% by non-bank financial institutions (Bank of England, 2018) and the remaining 14% by other investors. Within non-banks, CLO structures hold around 25% of the leveraged loan market, followed by investment funds (7%), mainly through US loan funds, while direct exposures of insurance and pension funds are more limited at around 4% of the total.

For CLOs, it is estimated that banks hold around one third of the tranches, while around two thirds of tranches are held by non-banks, in particular insurance, investment and pension funds. Banks typically hold higher-rated CLO tranches – half of AAA tranches are held by banks (Federal Reserve, 2019) – while riskier tranches are primarily held by asset managers, hedge funds and insurance companies. However, when CLOs are privately placed, data on investors and the underlying leveraged loans are scarce. In that context, the EU Securitisation Regulation – which entered into force in 2019 – has imposed new transparency requirements including loan-by-loan reporting which also cover CLOs. Looking forward, ESMA's securitisation templates will help close some of the data gaps (Box V.3).

V.3
Data gaps on CLOs

**ESMA's securitisation disclosure templates**

The EU Securitisation Regulation includes a number of due diligence and monitoring requirements for investors. In particular, the draft technical standards designed by ESMA should help improve the transparency of the securitisation market, including for CLOs (Amzallag, 2018).

The draft disclosure templates developed by ESMA and submitted to the European Commission for adoption include specific information on borrower financial variables (such as EBITDA) as well as leveraged loan characteristics (such as syndication and loan repayment profiles).

In addition to tracking information on CLO tranches and on the counterparties involved in the CLO, ESMA's securitisation templates also include dedicated sections requiring information on the CLO-specific features of the securitisation, as well as the profile and performance of the CLO manager (ESMA, 2019a). Even if it is difficult to track which parties are directly or indirectly exposed to CLOs, ESMA's templates seek to facilitate the assessment and monitoring of the evolution in risks contained in these instruments. Reporting of these templates is expected to begin later in 2019, once adopted by the European Parliament, Council and Commission. The templates must be made available and updated on a quarterly basis for investors and supervisory authorities.

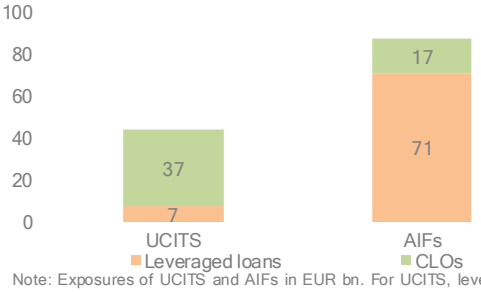
## EU investment funds exposures

The EU investment management legislation distinguishes between investment funds that qualify as UCITS and those that qualify as AIFs. UCITS can be marketed to retail investors and are subject to specific product requirements set out in the UCITS Directive. These requirements include, inter alia, diversification rules, limits on leverage and restrictions on assets they can invest in. In general, leveraged loans are not considered eligible assets for UCITS. Relatedly, UCITS can invest in CLOs, as long as the CLO is considered a transferable security.[85]

In contrast, AIFs are funds that typically target professional investors. They can invest in a wide range of assets (including asset classes not eligible for UCITS) and typically have no restrictions on leverage, although, at a national level, investment restrictions and leverage limits may exist.

Overall, EU funds exposures to leveraged loans and CLOs are limited, amounting to EUR 54bn for CLOs and EUR 78bn for leveraged loans (V.4)

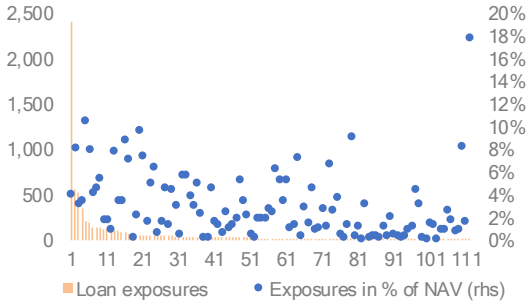
V.4
EU funds exposures to leveraged loans and CLOs
**Limited exposures**




Note: Exposures of UCITS and AIFs in EUR bn. For UCITS, leveraged loans also include bank loans, and CLOs include CMOs and CDOs. For AIFs, CLOs include also CDOs. Data for 2017 for AIFs and 2018 for UCITS.
Sources: Morningstar, AIFMD database, National Competent Authorities, ESMA.

The total exposures of UCITS to loans (which includes bank loans and leveraged loans) amounted to EUR 7.4bn as of the end of 2018, based on a sample of 1,365 funds (V.4).[86] Most of the exposure is concentrated in a few UCITS, with the top 20 accounting for 80% of loan exposures (V.5).

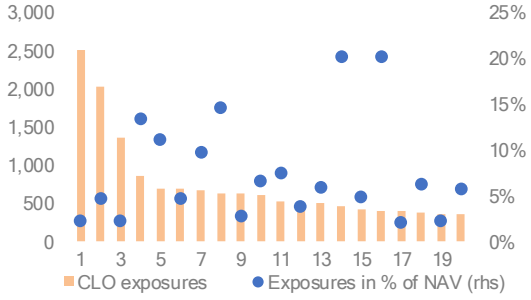
V.5
UCITS exposures to loans
**Concentrated in a few funds**




Note: Individual UCITS exposures to bank loans (top 112 UCITS in terms of loan exposures, x-axis), in EUR bn and in % of NAV (right axis).
Sources: Morningstar Direct, ESMA.

UCITS exposures to CLOs were larger, but still limited, at around EUR 36bn at the end of 2018 across 3,843 funds. Concentration is lower, with the top 20 accounting for 40% of CLO exposures (V.6). However, the data also include collateralised debt obligations (CDOs) and should therefore be interpreted as a maximum.

V.6
UCITS exposures to CLOs
**Low concentration**




Note: Individual UCITS exposures to CDO/CLOs (top 20, x-axis), in EUR mn and in % of NAV (right axis).
Sources: Morningstar Direct, ESMA.

Around 500 UCITS have exposures to both loans and CLOs. Only a few UCITS invest in both asset classes and have a combined exposure higher than 5% of NAV. For these funds, CLOs and loans account for less than 50% of their NAV.

The EU Alternative Investment Funds Managers Directive (AIFMD) introduces reporting requirements that cover AIFs' exposures to loans and CLOs (see ESMA, 2019b for an overview of the AIF market).[87] In particular, AIFs have to separately report their gross exposures to

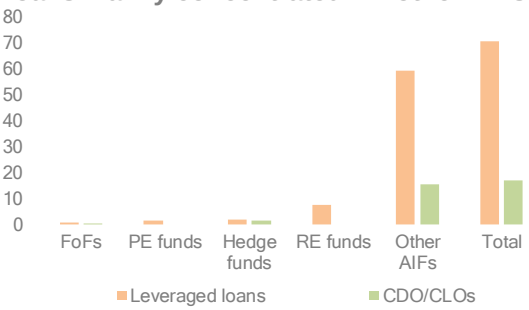
[85] Commission Directive 2007/16/EC.

[86] Since there are no proprietary data on UCITS at the EU level, we use commercial data to estimate UCITS exposures. The data come with the following shortcomings: loans include both leveraged loans and bank loans, while CLOs are bundled with collateralised mortgage obligations and collateralised debt obligations, without a breakdown by instrument.

[87] The AIFMD sets out extensive reporting requirements to NCAs for AIFMs. The reporting requirements include data on the characteristics of the AIF (type, strategy, concentration of investors) along with detailed information on assets (principal exposures, exposures by asset type and regional investment focus), as well as several risk features (market risk, liquidity profile, use of leverage and stress test results).

leveraged loans and to CDO/CLOs along with their ten largest individual exposures. Overall, based on data from the end of 2017, AIFs exposures to leveraged loans amount to EUR 71bn, and exposures to CDO/CLOs to EUR 17bn (V.7). This corresponds to 7% of the leveraged loan market and 5% of the CLO market at the end of 2017.[88] Exposures are spread across more than 500 AIFs, with a combined NAV of EUR 475bn, accounting for less than 10% of all AIFs. Looking at exposures by AIF types, around 85% of exposures are concentrated in 'other AIFs', a residual category, followed by real estate funds which account for 10% of AIF exposures to leveraged loans. This finding is in line with ESMA's report (ESMA, 2019b) which shows that 'other AIFs' account for close to two third of the NAV of the sector.

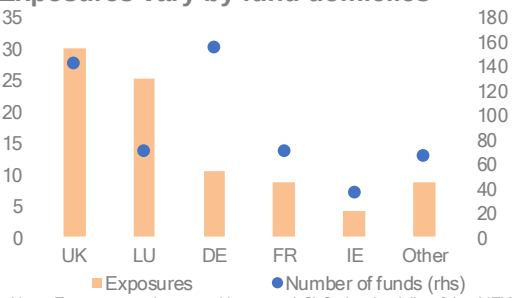
V.7
AIFs exposures by type
**Loans mainly concentrated in "other AIFs"**




Note: Gross exposures, in EUR bn.
Sources: AIFMD database, National Competent Authorities, ESMA.

Most AIFs with exposures to those markets are domiciled in a few EU countries, with the top five countries accounting for 90% of exposures (V.8).

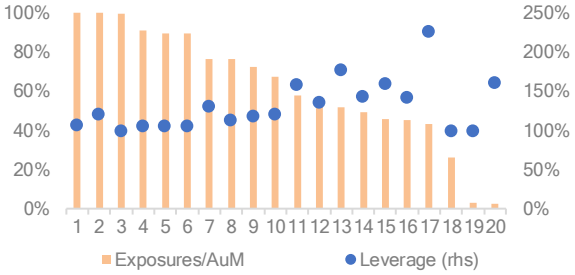
V.8
AIFs exposures by country
**Exposures vary by fund domiciles**




Note: Exposures to leveraged loans and CLOs by domicile of the AIFM, in EUR bn.
Sources: AIFMD database, National Competent Authorities, ESMA.

Most exposures are concentrated in a few funds, with the top 20 accounting for close to 50% of all exposures and the top 50 for 64%. AIFs with the largest exposures to leveraged loans and CLOs tend to invest mainly in these two asset classes: on average, they account for 60% of assets under management for the top 20 AIFs. For those AIFs, leverage – as measured by the ratio of AuM to NAV – is relatively limited, ranging from 100% to 200% with an average value of 130% (V.9).

V.9
Exposures of top 20 AIFs
**Limited leverage**




Note: Gross exposures to leveraged loans and CDO/CLOs in % of AuM and leverage defined as AUM to NAV. Data for the top 20 AIFs with the largest exposures to leveraged loans and CDO/CLOs in absolute amounts.
Sources: AIFMD database, National Competent Authorities, ESMA.

Finally, we look at potential liquidity mismatch for the 50 AIFs with the highest exposures to leveraged loans and CLOs. Redemptions from investors, in a context of stress in the leveraged loan and CLO markets, could force fund managers to liquidate their assets, thereby amplifying shocks to the financial system. Liquidity mismatch is assessed by comparing the liquidity of the portfolio and the investors' liquidity. Under AIFMD, AIFs have to report their liquidity profile by indicating the share of their NAV that can be redeemed over a set of specified time buckets (less than one day, between two and seven days, etc.), and the same information for their portfolio of assets. We aggregate indicators for 50 AIFs, to compute the weighted average measure of portfolio liquidity. Taking the weighted average of portfolio and investor liquidity based on the NAV of the AIF could introduce some bias, as funds with 'excess liquidity' (portfolio liquidity higher than investor liquidity) could compensate funds with liquidity mismatch. Therefore, we do not take into account the 'excess liquidity' of AIFs.

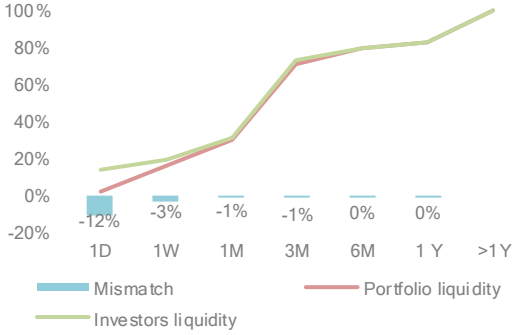
The top 50 AIFs face a liquidity mismatch in the short term: Investors can redeem up to 13% of the NAV within a day, while only 1% of the assets can be liquidated over this time frame, resulting in a liquidity mismatch equal to 12% of NAV (V.10). The liquidity mismatch is concentrated in a few funds – accounting for 12% of NAV – which offer daily liquidity to investors, while investing in

[88] The analysis covers only AIFs managed by EU AIFMs. AIFs managed by non-EU AIFMs operating under National Private Placement Regimes are excluded.

leveraged loans and CLOs. Over longer time horizons the mismatch is limited, with 3% over one week and close to zero afterwards.

Overall, the analysis points to limited risks for AIFs as overall exposures are relatively limited (less than 2% of AIFs' NAV), and AIFs with the highest exposures are not highly leveraged. However, residual risks exist regarding liquidity mismatch for the few AIFs that offer daily liquidity to investors and for AIFs which have concentrated exposures to leveraged loans and CLOs.

V.10
Liquidity profile of top 50 AIFs
**Liquidity mismatch at the short end**




Note: Portfolio and investor liquidity, in % of NAV, weighted average. D=Day, W=Week, M=Month and Y=Year. Portfolio liquidity indicates the cumulative share of the NAV that can be liquidated over time, and investor liquidity the cumulative share of the NAV that can be redeemed over the same time horizon.
Sources: AIFMD database, National Competent Authorities, ESMA.

## Risks in the leveraged loan and CLO markets

### Deterioration of loan credit quality and liquidity risk

The average credit ratings of outstanding leveraged loans have recently deteriorated (IMF, 2019). With signs of a global economic slowdown, there is a risk that the next recession might lead to a wave of defaults among leveraged loans borrowers, with corresponding losses for investors in the leveraged loan market.

Since leveraged loans are positioned higher in the capital structure than HY bonds, the recovery rate has tended to be higher in the past (and yields on HY bonds were therefore higher than on loans). In the case of a default, HY bondholders absorb losses before leveraged loans creditors.

However, in recent months, the HY-leveraged loan spread has turned negative, reflecting concerns that the recovery rate in case of default will be lower for leveraged loans, given that borrowers are more indebted than before, and some of them did not issue bonds (which absorb losses before loans; V.11).

V.11
HY bonds - leveraged loans spread
**Spread turned negative**

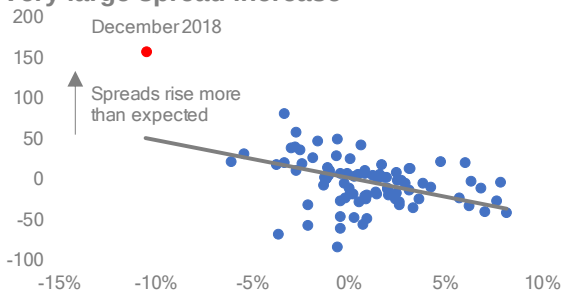

Note: Spread between yields on US HY index and US leveraged loan index.
Sources: Thomson Reuters Datastream, JPMorgan, ESMA.

In that context, it is unclear to what extent CLO managers and investors would be able to absorb those losses seamlessly. Indeed, if the credit quality of leveraged loans were to deteriorate significantly, some investors might need to sell loans, potentially creating negative price spirals and feedback loops. Materialisation of this risk depends on a range of factors, including the structure of the investor base (retail, institutional investors or banks) or the existence of a potential liquidity mismatch.

US mutual loan funds might be more exposed than UCITS to this type of risk, as US loan funds have no limit on leveraged loans exposures. They invest in leveraged loans while providing daily liquidity to investors (Haquin, 2015, and Federal Reserve, 2019). If investors were to redeem on a large scale, loan funds would need to liquidate their holdings of leveraged loans, with a potential sharp impact on the market. In addition, leveraged loan transactions typically settle within 30 days, which exposes fund investors to settlement risk.

The market turbulence of December 2018 provides an example of this dynamic: US loan funds experienced their largest outflows on record (higher than 10% of NAV), while spreads on leveraged loans increased sharply. Spreads were particularly sensitive to fund outflows, as they increased by more than suggested by historical relationships (V.12; see red dot above the black line).

V.12
Leveraged loans and loan funds
**Very large spread increase**




Note: Monthly change in leveraged loans spreads (y-axis) in bps and monthly net flows from US loan funds (in % of NAV).
Sources: Lipper, ESMA.

However, loan funds proved resilient during the episode, as no fund was forced to suspend redemptions. In addition, CLO structures have limited maturity risk, as the duration of the leveraged loans held are in line with the duration of CLO tranches issued, which reduces rollover risk.

Finally, an additional risk lies in the potential for a wave of rating downgrades, which could have procyclical effects, as holders of leveraged loans might need to liquidate some of their holdings. Usually, CLO managers or trustees value leveraged loans at face value when calculating over-collateralisation requirements (i.e. the amount by which the par amount of the collateral must exceed the par amount of the issued CLO tranches). However, when the share of leveraged loans rated below B- exceeds a specified percentage, the excess is valued at market value (Fitch, 2018). Therefore, CLOs might need to sell the loans to meet the overcollateralisation requirement, at a time where the liquidity in the underlying loan market could deteriorate, thereby amplifying the price decline.

In that context, the credit ratings of CLO tranches are a key parameter for CLO investors, as some investors such as banks will only invest in the highest-rated (AAA) tranches. However, the complexity of CLO structures might lead to model risk, especially regarding the modelling of default correlation among leveraged loans in the CLO portfolio. An unexpected rise in default rates correlation could lead to ratings downgrades which could result in forced sales from investors, thereby putting downward pressure on the CLO and leveraged loans markets. In addition, there tends to be a large overlap among CLO, as CLOs are exposed to the same borrowers. Based on a sample of 902 CLOs, J.P. Morgan reports that 92% have exposure to at least one of the top 50 borrowers (J.P. Morgan, 2019b). A default of the borrower would then impact several CLOs at the same time. Therefore, we analyse model risk more precisely in the next section using a simulation framework.

## Model uncertainty and risks of rating downgrades for CLOs

### Credit ratings and modelling risks

The potential for an underestimation of default risks and the possibility of sudden CLO rating downgrades represent a risk for markets and investors. The global financial crisis has shown how flawed rating methodologies can lead to inflated ratings and amplify shocks to the financial system. Moreover, this risk is generally not anticipated. Indeed, investors use credit rating to assess their exposure to credit risk, but they may not consider the possibility that this assessment could underestimate this risk, eventually exposing them to higher credit risk.

The risk of being misled by a model is called model risk. Coval et al. (2009) have shown how in the run-up to the global financial crisis, credit ratings were extremely sensitive to the parameters used by CRAs. The authors show how changes in default probability and correlation of defaults can lead to dramatic changes to credit ratings. More recently, Nickerson and Griffin (2017) find that CRAs tend to underestimate default correlation. The authors estimate that CRAs assume a default correlation of 3%, against a higher estimate of 12% based on a model that includes observable and unobservable risk factors. The authors conclude that credit risk is understated by 26% when comparing their estimates of default correlation with the assumptions used by CRAs.

### Correlation of defaults and credit ratings

To illustrate how model and parameter uncertainty can impact credit ratings, we conduct a simulation exercise. We construct a CLO composed of 100 leveraged loans with the same probability of default of 20%, which corresponds to the five-year average default probability of B-rated loans. The CLO structure is divided into four “tranches” corresponding to different levels of risk. The equity tranche is the riskiest and absorbs the first 8% of losses, followed by the junior tranche (up to 20%), the mezzanine tranche (up to 40%) and finally the senior tranche (V.13 and V.14). For example, if losses reach 10%, the equity tranche is wiped out and the junior tranche absorbs the remaining losses, i.e. 2%. For simplicity, we do not consider pre-payment or interest rate risk in the model, in order

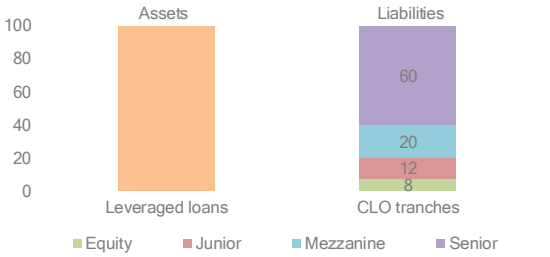
to focus mainly on correlation, nor any overcollateralisation of the CLO (where the face value of the leveraged loans is higher than CLO liabilities).

V.13
CLO modelling
**Summary of assumptions**

| | Parameter |
|---|---|
| Number of leveraged loans | 100 |
| Maturity | 5 years |
| Recovery rate | 50% |
| Default rate | 20% |
| Default correlation | 0% |
| Equity tranche | [0%, 8%] |
| Junior | [8%, 20%] |
| Mezzanine | [20%, 40%] |
| Senior | [40%, 100%] |

Source: ESMA.

V.14
Simplified CLO structure
**Assets and liabilities**




Note: Structure of the CLO used in the simulation. Figures refer to the percentage of tranches outstanding by seniority.
Sources: ESMA.

We run 100,000 simulations and compute the default rate for each tranche (see Box V.15 for details), using different values for the correlation of defaults.

V.15
CLO modelling
**Estimation of default probabilities**

Given the structure of the CLO, as long as the losses are absorbed by the lower tranches, the senior tranches get fully repaid. If losses are higher than the attachment point $A$ but lower than the detachment point $D$, the subordinateds tranches (i.e. equity and junior tranches) get partially repaid to all of that tranche's noteholder on a pro-rata basis. Finally, if losses are higher than the detachment point, the cumulative losses are equal to the overall size of the subordinated tranches, wiping out the tranches entirely. For example, if losses are equal to 20% of notional, the equity and the junior tranches are entirely wiped out, but the higher tranches (i.e. mezzanine and senior) get fully repaid.

Let $L_M$ denote the cumulative loss on a given tranche and $L$ be the cumulative loss on the whole portfolio of loans. The expected loss for each tranche $M$, given its attachment $A_M$ and detachment points $D_M$ is equal to

$$E[L_M] = \frac{1}{M}\sum_{i=1}^{M}\left\{\frac{max(L_i - A_M; 0) - max(L_i - D_M; 0)}{D_M - A_M}\right\}$$

Given the expected loss, we can compute the market price, assuming risk-neutral investors:

$$e^{-(r+s_M)T} = (1 - E[L_M])e^{-rT}$$

Setting the risk-free rate to zero for simplicity yields the following expression for the spread:

$$s_M = -\frac{1}{T}ln(1 - E[L_M])$$

Finally, the default rate $p_M$ derived from spreads is given by:

$$p_M = 1 - e^{\left(\frac{-s_M T}{1-R}\right)}$$

Credit ratings for higher tranches are directly impacted by the default correlation (Table V.16). In particular, for correlations higher than 0, the mezzanine tranche loses its AAA rating. For correlations higher than 35%, the senior tranche also loses its AAA rating. Similar results are found by S&P (2015) when increasing asset correlation within and between industries.

V.16
CLO modelling
**Market-implied ratings**

| | $\rho = 0$ | $\rho = 0.2$ | $\rho = 0.4$ | $\rho = 0.6$ | $\rho = 0.8$ |
|---|---|---|---|---|---|
| Junior | B- | CCC+ | CCC+ | CCC+ | CCC+ |
| Mezzanine | AAA | BBB- | BB- | B+ | B- |
| Senior | AAA | AAA | AA+ | A | BBB |

Note: Credit ratings implied by the 5-year expected default rate as a function of the correlation of defaults $\rho$.
Sources: ESMA.

Although the assumption related to the correlation of defaults is key to assessing credit risk for CLOs, it is challenging to estimate this parameter given that defaults are infrequent. Qi et al. (2019), using data from 1970 to 2014, estimate a default correlation of 10% over five years for B-rated bonds and 19% for C-rated bonds. Using data on US firms over the period between 1992 and 2013, Li and Chen (2018) report higher values, with a five-year correlation of defaults among firms with low credit quality (lower than BB) as high as 38%, which can almost double during crisis periods.

## Modelling joint extreme events

Another source of model uncertainty is related to the modelling of joint extreme events. Indeed, simultaneous defaults on leveraged loans might be more likely to occur during recessions than during economic expansions. However, in the EU and the US, most CLO models use the Gaussian copula, where the default dependence is entirely characterised by the correlation coefficient (Fitch, 2018). This implies that the occurrence of extreme events – such as the simultaneous

defaults of leveraged loan borrowers – is underestimated.

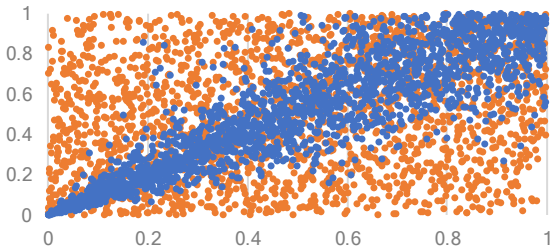
Some copulas, such as the Student copula and the Clayton copula, integrate more complex dependence structures which can account for the possibility of large simultaneous defaults on leveraged loans (for details see Burtschell et al., 2009, and Yoshiba, 2015). Box V.17 outlines how the dependence structure can be modelled using different types of copulas.

V.17
CLO modelling
**Modelling complex dependence structures**

The occurrence of simultaneous defaults is a key factor in the evaluation of CLOs. In the case of a Gaussian copula, the full dependence structure depends on one parameter: the correlation. In other words, the probability of having simultaneous defaults in good, normal or bad states of the world is identical. One drawback is that this type of copula is not able to model joint extreme events. In other copula models, it is possible to introduce a more complex dependence structure, where default arrivals can change depending on the tail of the distribution (tail dependence). For example, Student copulas exhibit symmetrical tail dependence while Clayton copulas have left-tail dependence.

Chart V.18 shows a sample of 2,000 points randomly drawn from a Gaussian copula (in orange) and a Clayton copula (in blue), characterised by high left-tail dependence. For the Gaussian copula, the points are spread all over the area, with no specific pattern in the tails. In contrast, when values are close to zero, points are clustered in the case of the Clayton copula. This indicates that in bad states of the economy, simultaneous defaults are more likely to occur.

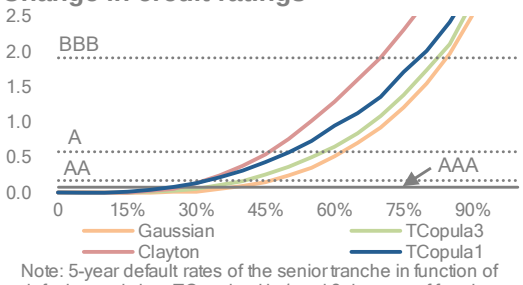
V.18
Dependence structure
**Gaussian and Clayton copulas**




Note: Sample points using a correlation of 20% for a Gaussian copula (orange) and a Clayton copula (blue) with a parameter of 5.
Sources: ESMA.

We compare the implied credit ratings of the CLO for the senior tranche using different copula models. The Gaussian copula provides the highest credit ratings, since the tranche is rated A or lower only when the correlation is higher than 65% (V.19). For Student and Clayton copulas, an equivalent rating is obtained with lower correlation values (around 40-50%; Table V.20). This example illustrates how changes in modelling approaches can have a significant impact on credit ratings.

V.19
Senior tranche
**Change in credit ratings**




Note: 5-year default rates of the senior tranche in function of default correlation. TCopula with 1 and 3 degrees of freedom.
Sources: ESMA.

V.20
CLO modelling
**Market-implied ratings**

| | $\rho = 0$ | $\rho = 0.2$ | $\rho = 0.4$ | $\rho = 0.6$ | $\rho = 0.8$ |
|---|---|---|---|---|---|
| | | | **Mezzanine** | | |
| Gaussian | AAA | BBB- | BB- | B+ | B- |
| Student | A | BB+ | BB- | B | B- |
| Clayton | AAA | BB | B+ | B- | B- |
| | | | **Senior** | | |
| Gaussian | AAA | AAA | AA+ | A | BBB |
| Student | AAA | AAA | AA | A- | BBB |
| Clayton | AAA | AAA | A+ | BBB | BBB- |

Note: Credit ratings implied by the 5-year expected default rate as function of the correlation of defaults $\rho$ and the copula. Student copula with three degrees of freedom. The parameter for the Clayton copula is chosen based on the corresponding Kendall's tau for each correlation coefficient.
Sources: ESMA.

## Lower recovery rates and the next recession

Given the deteriorating credit quality of borrowers and the decline in underwriting standards, recovery rates could be substantially lower than in the past in the event of a default (IMF, 2018a).

To assess the impact of lower recovery rates on credit ratings, we assume a recovery rate of 35%, in line with the level reached by defaulted leveraged loans in 2009. Intuitively, credit ratings would be lower for all tranches and across models compared to the baseline recovery rate of 50%, with the largest downgrades for models exhibiting tail dependence (Table V.21).

V.21
Lower recovery rates
**Market-implied ratings**

| | Baseline | Lower recovery rates |
|---|---|---|
| | **Mezzanine** | |
| Gaussian | BBB- | BB- |
| Student | BB+ | B+ |
| Clayton | BB | B+ |
| | **Senior** | |
| Gaussian | AAA | AA+ |
| Student | AAA | A+ |
| Clayton | AAA | A |

Note: Credit ratings implied by the 5-year expected default rate as function of recovery rate and the copula. Student copula with three degrees of freedom. The parameter for the Clayton copula is chosen based on the corresponding Kendall's tau for each correlation coefficient.
Sources: ESMA.

The results presented in this section illustrate how model risk can lead to a revision of credit ratings. Those risks crystallised during the global financial crisis in the case of CDOs, leading to numerous ratings downgrades and peaks in default rates. However, some of the risks might be mitigated in the current context.

Following the global financial crisis, CRAs have revised their methodologies. In particular, some CRAs include correlation add-ons when the underlying collateral belong to the same industry and/or regions (S&P's, 2016, Fitch, 2018, Moody's, 2019). Also, a regulatory and supervisory framework has been developed in the EU, with ESMA as the supervisor of CRAs. ESMA intends to further enhance its monitoring activities in this area, so as to ensure that CRAs comply with the relevant requirements set out in the CRA Regulation.

In addition, current CLO structures (so-called CLO 2.0) have a range of differences compared to pre-crisis CLOs. Under the CLO 2.0 structure, equity tranches are thicker, which implies a higher required level of default for AAA tranches to be affected. Relatedly, CLOs 2.0 have tighter collateral eligibility requirements (including on the place of issue of leveraged loans) and shorter reinvestment periods, which reduce interest rate risk for investors. Finally, the risk retention rule set out in EU regulations after the crisis requires that the originator of the CLO retains at least 5% of the risk of the exposure on its balance sheet, in contrast to the originate-and-distribute model used before.

## Conclusion

The surge in the issuance of leveraged loans and CLOs is an indication of how market-based finance can supplement bank credit to finance the real economy, and in particular borrowers, with substandard credit quality. At the same time, the deterioration of underwriting standards coupled with low spreads on leveraged loans point to a potential underpricing of risk.

It is therefore crucial to actively monitor the leveraged loan and CLO markets' developments and continue to address data gaps to ensure an adequate coverage of financial institutions exposures to those markets.

At this stage, based on data from the end of 2017, EU fund exposures appear relatively limited, and concentrated in a few AIFs and UCITS. The AIFs with large leveraged loans and CLO exposures use limited leverage and do not face a significant liquidity mismatch, with the exception of a few AIFs offering daily liquidity to investors.

Since the credit ratings of CLO tranches are a key parameter for CLO investors, the potential for sudden CLO rating downgrades represents a risk for markets and investors. Simulations show that an increase in the correlation of defaults can lead to substantial credit rating downgrades, especially when the possibility of extreme events is considered. This shows that investors should take into account model uncertainty for CLOs in their investment decisions.

Looking ahead, it is crucial to make sure that CRA methodologies used for assessing the credit ratings of CLOs remain robust – paying particular attention to the modelling of defaults among the underlying collateral – and that investors perform proper due diligence. In 2019 ESMA will review the quality of CLOs' rating processes and methodologies. Among others, ESMA will look into the rigorousness, validation and historical back-testing of CLO rating methodologies, their systematic application as well as the adequacy of CRAs' arrangements to incorporate new information into CLO ratings in a timely manner.

## References


Amzallag, A. (2018), “Enhancing transparency of EU securitisations”, ESMA Report on Trends, Risks and Vulnerabilities, No.2, 2018.

Armstrong, P. and Turulja, A. (2015), “Bank loan mutual funds – US case and implications for Europe”, ESMA Report on Trends, Risks and Vulnerabilities, No.2, 2015.

Bank of England (2018), “Leveraged lending”, Financial Stability Report, No.44, November.

Burtschell, X., Gregory, J. and Laurent, J. (2009), “A comparative analysis of CDO pricing models under the factor copula framework”, The Journal of Derivatives, Vol. 16, No.4, pp. 9-37.

Coval, J., Jurek, J. and Stafford, E. (2009), “The Economics of Structured Finance”, Journal of Economic Perspectives, 23(1), pp. 3-25.

European Central Bank (2017), “Guidance on leveraged transactions”, May.

European Central Bank (2018), “Leveraged loans: a fast-growing high-yield market”, Financial Stability Review, May.

European Securities and Markets Authority (2019a), “Amendments to ESMA’s draft technical standards on disclosure requirements under the Securitisation Regulation”, Opinion.

European Securities and Markets Authority (2019b), “EU Alternative Investment Funds”, ESMA Annual Statistical Report.

Federal Reserve Board (2019), “Vulnerabilities Associated with Elevated Business Debt”, Financial Stability Report, May.

Fitch (2018), “CLOs and Corporate CDOs Rating Criteria”, July.

Haquin, J. (2015), “Fund investments in loan participation and loan origination – nascent market, big risks?”, ESMA Report on Trends, Risks and Vulnerabilities, No.1, 2015.

International Monetary Fund (2018a), “A Bumpy road ahead”, Global Financial Stability Report, April.

International Monetary Fund (2018b), “A Decade after the Global Financial Crisis: Are We Safer?”, Global Financial Stability Report, October.

International Monetary Fund (2019), “Vulnerabilities in Maturing Credit Cycle”, Global Financial Stability Report, April.

J.P. Morgan (2019a), “2018 Leveraged Loan Annual Review”, February.

J.P. Morgan (2019b), “CLO Credit Concentration Risk: A Guide”, Global Credit Research, March.

Li, L. and Chen, C. (2018), “The domino effect of credit defaults: test of asymmetric default correlation using realised default data”, Applied Economics, Vol. 50, No.44, pp. 4803-4813.

Moody’s (2019), “Moody’s global approach to rating collateralized loan obligations”, Rating methodology.

Nickerson, J. and Griffin, J. (2017), “Debt correlations in the wake of the financial crisis: What are appropriate default correlations for structured products?”, Journal of Financial Economics, Vol. 125, No.30, pp. 454-474.

Qi, H., Shi, J. and Xie, Y. (2019), “Default correlation: rating, industry ripple effect and business cycle”, Applied Economics, Vol. 51, No.30, pp. 3256-3273.

Standard & Poor’s (2015), “Scenario and Sensitivity Analysis: 2015 EMEA Structured Credit Scenario and Sensitivity Analysis”, Structure Finance.

Standard & Poor’s (2016), “Global methodologies and assumptions for corporate cash flow and synthetic CDOs”, Structured Finance.

Yoshiba, T. (2015), “Risk aggregation with Copula for banking industry”, IMES Discussion Paper No.2015-E-1.