HONG KONG MONETARY AUTHORITY

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AN ASSESSMENT OF THE VULNERABILITIES OF OPEN-ENDED FUNDS TO LEVERAGED LOANS

Key points:

- *Leveraged loans (LLs), which are illiquid and carry significant default risk, have grown rapidly alongside their securitised products (i.e. Collateralised Loan Obligations, CLOs). Investment funds are the second largest holder of these assets after banks, causing financial stability concerns about the liquidity risk of open-ended funds and the spillover risk to banks through common holdings of LLs.*

- *By examining the portfolios of open-ended funds that invested in LLs or CLOs around the world, this study finds that although the aggregate exposures to these assets remained limited at around 4% of their total assets at end-2019, and only 2% of these open-ended funds invested heavily in LLs (i.e. >50% of the fund's assets, referred to as 'LL funds'), fire-sales of LLs by such a small portion of funds could generate a downward spiral in LL prices and sharp fund outflows. In particular, during the March-2020 episode, these LL funds sold US$14 bn of LLs, accounting for 11% of the transactions in the secondary LL market and contributing to the sharp drop of 19% in LL prices during the episode.*

- *Our empirical analysis shows further that the fire-sales may mainly stem from the liquidity risk of LL funds, which is estimated to be higher than that of high-yield (HY) bond funds. During times of stress, a one percentage point (ppt) drop in funds' return would lead to fund outflows by 1.5 ppts for LL funds, much higher than the estimate of 0.7 ppts for HY bond funds.*

- *We also identify factors that amplify the liquidity risk of LL funds. Specifically, we find that LL funds' holding of LLs are highly pro-cyclical, and they hold significant common LLs. These could make LL funds more susceptible to fire-sales when there is a shock to LL prices, putting downward pressure on LL funds returns and amplifying outflows from them. However, most of LL funds employed little leverage, making it unlikely a significant factor in amplifying the risk.*

- *Given the rising issuance of LLs and the continued search-for-yield by investors amid the abundant global liquidity conditions, open-ended funds' exposure to LLs could increase further. This calls for close monitoring and policy to address the risks identified by this study. In this regard, our findings have two policy implications:*

    i. *Bridging the data gaps to monitor the holdings of LLs by banks and non-bank financial institutions is important, as the identification of common exposures plays a key role in assessing the potential spillover risks.*

    ii. *Given the large liquidity risk facing LL funds and the potential spillovers to the financial system, policy to strengthen LL funds' liquidity management (e.g. lowering the dealing frequency and requiring a higher buffer of liquid assets) may help address the root cause of vulnerabilities, while additional limits on leverage may be less effective.*

Prepared by: *Gabriel Wu, Joe Wong and Tom Fong**

Market Research Division, Research Department

Hong Kong Monetary Authority

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I. INTRODUCTION

The markets for leveraged loans (LLs) together with the securitisation market of LLs (i.e. Collateralised Loan Obligations, CLOs) have grown significantly in recent years.[1,2] Given that LLs are highly illiquid with higher credit risks, the rapid growth of these markets could have significant financial stability implications.

In particular, investment funds are the second largest holder of LLs and CLOs after banks, according to the Financial Stability Board (FSB, 2019).[3] The lower credit quality and thin liquidity of LLs may subject those investment funds with exposure to LLs and CLOs, in particular open-ended funds, to high liquidity risk. Liquidity risk in open-ended funds arises as they are committed to meet investors' redemptions promptly (for instance, daily), while selling their LLs or CLOs to honor the redemptions would take a much longer time due to the lack of liquidity. Therefore, large redemptions in times of stress could expose these open-ended funds to high liquidity risk.

More importantly, high liquidity risk of these open-ended funds could force them to fire-sell their holdings of LLs or CLOs, putting downward pressures on the prices of these assets. In turn, the price fall lowers the returns of these funds and results in further outflows, forming a downward spiral between LLs or CLOs prices and fund outflows. Such a downward spiral could cause financial stability concerns as the risk could spillover to the global banking sector (which holds the lion's share of these assets) through common holdings of these assets.

Against this backdrop, this study assesses open-ended funds' exposure to LLs and CLOs and the implications for financial stability risks, an area that has not been well explored in literature (Banegas and Goldenring, 2019). Our primary focus is the liquidity risk caused by these exposures, as it could result in potential financial stability risks mentioned above. Apart from that, we also assess the extent of pro-cyclicality and commonality in the holdings of LLs and CLOs, as well as the

[1] There is no universal definition of LLs, although they broadly refer to loans to borrowers with lower credit quality. Annex A lists some common definitions of LLs. The size of LLs could vary vastly between reports or sources, depending on the definition used.

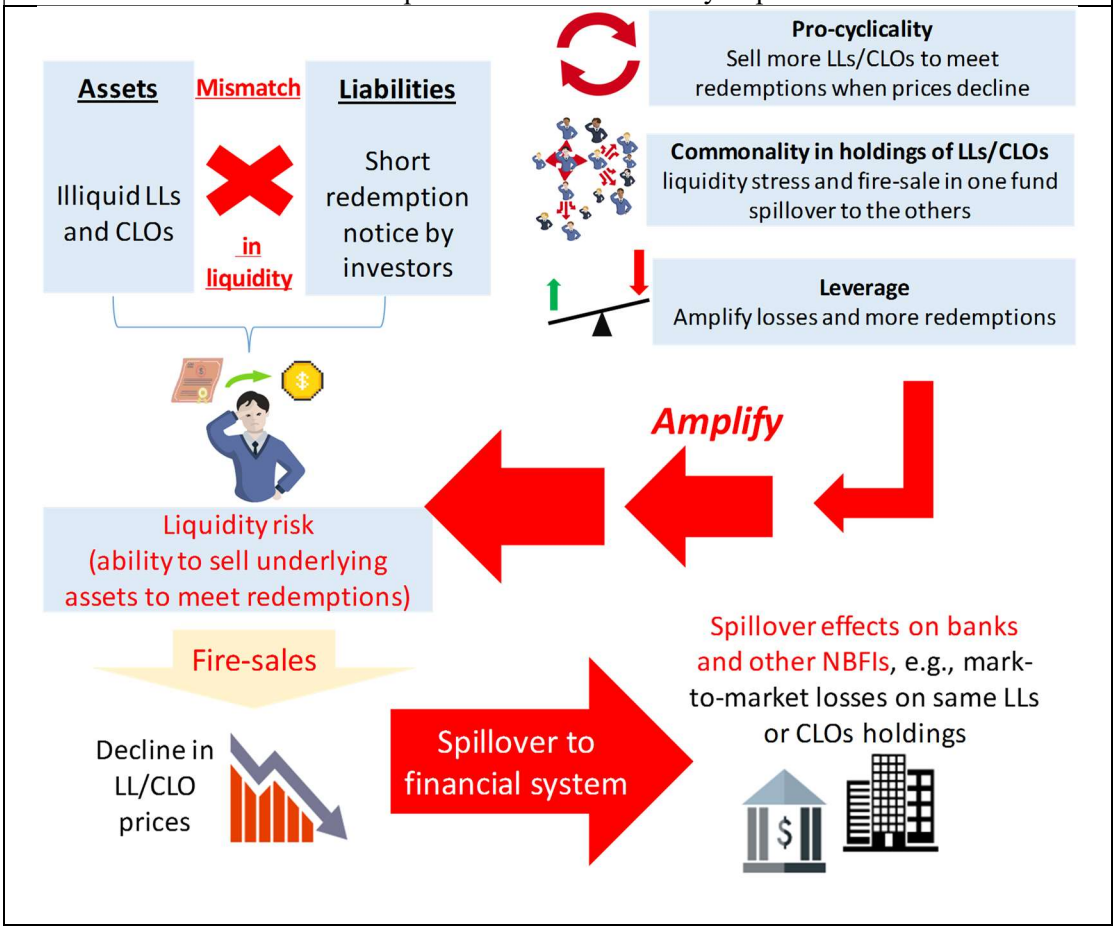
[2] According to IMF (2020), the size of global LLs markets has about doubled since the Global Financial Crisis (from US$ 2.8 tn in 2009 to US$ 5.5 tn in 2019). The outstanding CLOs in the US and Europe have also grown by similar pace during the same period (from US$ 385 bn to US$ 762 bn).

[3] This is based on the LLs and CLOs where the FSB can identify the owners (about 79% of the outstanding LLs and CLOs at December 2018).

leverage in these open-ended funds, given that these factors could amplify the vulnerabilities associated with liquidity risk (see Chart 1 below).[4]

This study is organised as follows. The next section provides a brief overview of LLs and CLOs. Section 3 examines open-ended funds' exposure to LLs and CLOs, using detailed portfolio data, and determine where the vulnerabilities lie. Based on the sources of vulnerabilities identified, Section 4 assesses the risks empirically. The final section concludes.

Chart 1: Illustration of risks faced by open-ended funds holding significant LLs and CLOs and the potential financial stability impact



[4] See ESMA (2019), FSB (2019) and Vivar et al. (2020) for more discussions on their associations.

II. AN OVERVIEW ON LEVERAGED LOANS AND COLLATERALIZED LOAN OBLIGATIONS

Chart 2 provides a schematic view of LLs and CLOs. LLs, together with high yield (HY) bonds, make up the leveraged finance market that finances risky corporate borrowers.[5] A LL is first structured, arranged, and administered by one or several commercial or investment banks before being sold (or syndicated) to other banks or institutional investors. The proceeds of LLs are mainly for leveraged buy-outs (LBOs), mergers and acquisitions (M&A), recapitalisation or refinancing of debt.

The LL market has grown rapidly since the global financial crisis (GFC). One major driver of this growth has been strong demand from investors (BIS, 2018), as the prolonged low interest rate environment amid the GFC has stimulated their search-for-yield behavior by holding riskier assets that offer higher returns. The demand for LLs has remained strong despite the US interest rate normalisation in 2015, as LLs are generally priced with floating rates. Although the returns for holding LLs increase along with rising interest rates, the default risk of LLs can be higher due to a greater debt-servicing burden for the borrowers.

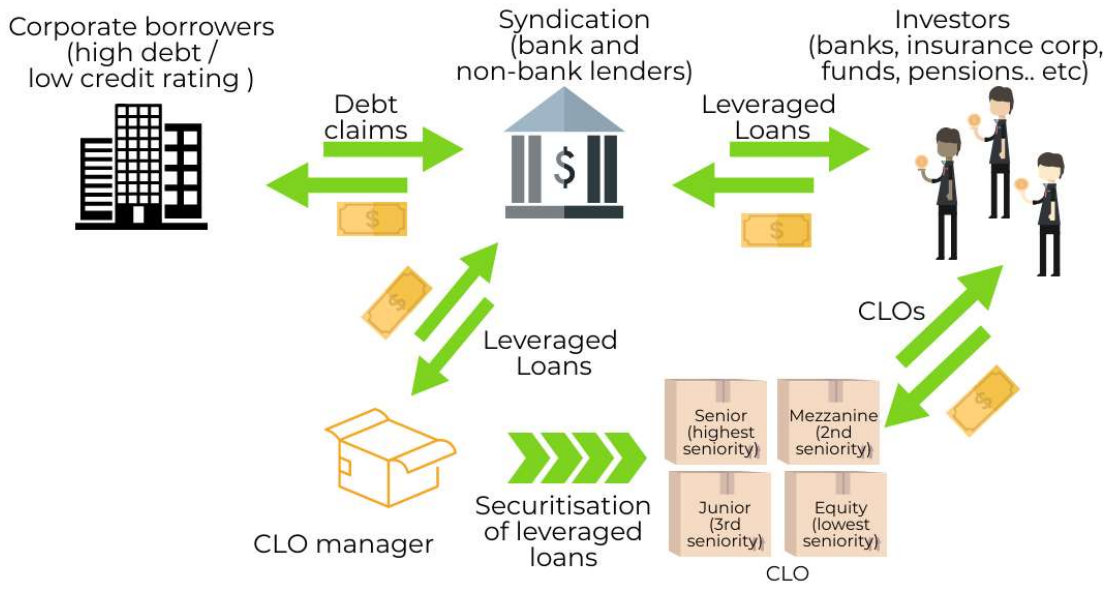
Developments in the securitisation market have also contributed to the growth in LLs, as investors are allowed to invest in a wide range of LLs and diversify the idiosyncratic risk in LLs. As a usual market practice, special purpose vehicles (SPV) are set up to acquire a portfolio of LLs.[6] These LLs will be securitised by issuing CLOs, which are further assigned different risk tranches. Each CLO tranche has a different priority of claim on cash-flow distributions and exposure to risk of loss from the underlying LLs. Senior tranches are the least risky tranche, followed by mezzanine junior and equity tranches.[7] Like LLs, CLOs are often sold to institutional investors such as banks and investment funds.

[5] See Annex A for a comparison of LLs and HY bonds.

[6] CLO portfolios may include various other assets such as second lien loans or unsecured debt, such as HY bonds, albeit at a much smaller scale.

[7] More specifically, senior (equity) tranche holders will be the first (last) to receive income generated by underlying LLs, and last (first) one to incur any losses due to the defaults of underlying LLs. To compensate for these risks, an equity tranche will generally receive a higher interest payment than senior and mezzanine holders.

Chart 2: Schematic view of LL and CLOs markets



III. How much are open-ended funds exposed to LLs and CLOs? Where do the vulnerabilities lie?

Using fund-level portfolio data from Morningstar, we identified a total of 7,377 investment funds around the world that invested in LLs or CLOs at the end of 2019. A majority of these investment funds were open-ended funds (i.e. 6,148 funds, accounting for 83% of total fund counts).[8]

The aggregate exposure of these open-ended funds to LLs and CLOs is found to be limited. At the end of 2019, the aggregate holding of LLs and CLOs of these 6,148 open-ended funds were US$182 bn and US$60 bn, respectively. These together accounted for only 4% of their total assets (Chart 3). **The exposure is highly concentrated in open-ended funds domiciled in North America**, which held 73% of the aggregate exposure of US$242 bn to LLs and CLOs. This is followed by those in Europe (25%) and to a much lesser extent in the Asia Pacific region (2%).[9]

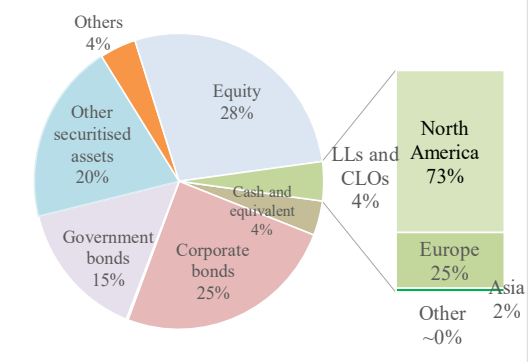
Another noteworthy observation is that the exposure to LLs is highly concentrated in a few open-ended funds. At the end of 2019, there were 107 open-ended funds which had invested more than half of their portfolios in LLs

[8] Annex B describes the data used in this study. The major data source of this study is Morningstar. Morningstar's data providers do not guarantee the accuracy, completeness or timeliness of any information provided by them and shall have no liability for their use.

[9] The exposure of funds in Asia-Pacific is mainly from a few funds in South Korea and Australia that invest heavily in LLs.

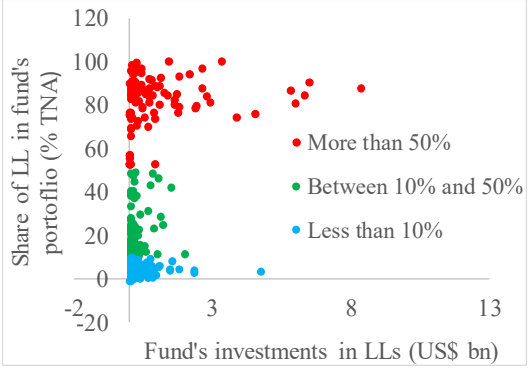
(referred to as 'LL funds' thereafter; represented by the red marks in Chart 4). While this accounts for only 2% of the 6,148 funds mentioned above, these funds together held US$100 bn, or 56% of the total US$182 bn LLs investment by open-ended funds. This, together with the fact that LLs on average accounted for about 84% of total net assets (TNA) of these funds, might imply they could be particularly prone to liquidity shocks to the LLs market; or a run on these funds could create significant downward pressure on the price of LLs.

Chart 3: Open-ended funds' investments in LLs and CLOs



Notes: (1) The pie chart depicts the aggregate portfolio compositions for all open-ended funds with investment in LLs or CLOs, while the bar charts depicts the distribution of LLs and CLOs investments by funds' region of domicile. (2) Positions at the end of 2019.
Source: Morningstar and authors' estimates

Chart 4: LLs investments by open-ended funds



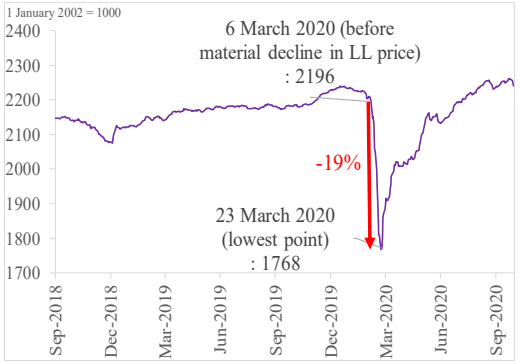
Notes: (1) The scatter plot depicts the exposures of LLs by open-ended funds measured in share to fund's assets (% of TNA) against the funds measured in value terms (US$ bn). (2) The red / green / blue marks denote those with more than 50% / between 10% and 50% / less than 10% of fund's TNA in LLs respectively. (3) Positions at the end of 2019.
Source: Morningstar and authors' estimates.

The March-2020 episode reveals the vulnerabilities of these LL funds and the extent to which their selling pressure could affect the resilience of LL markets. Specifically, these LL funds sold US$14 bn of LLs during this episode. Such selling volume accounted for about 11% of the transactions in the secondary LL market,[10] contributing to the sharp drop of 19% in LL prices (Chart 5) in March-2020. The price fall could pose challenges for the wider financial sector. For example, other financial institutions, particularly banks, could suffer from a huge mark-to-market loss, and such losses could be material given the large aggregate exposure of banks to LLs.

[10] The figure is calculated by dividing US$14 bn (i.e. sell-off of LLs by LL funds) by US$128 bn, the total LL transactions in the secondary market in the US (US$120 bn, according to the Loan Syndications and Trading Association) and Europe, Middle East and Africa (US$8 bn, the monthly average of the US$24 bn transactions in Q1 2020, according to Refinitiv) in March-2020. LLs from these regions accounted for 95% of the LLs held by the LL funds in our sample.

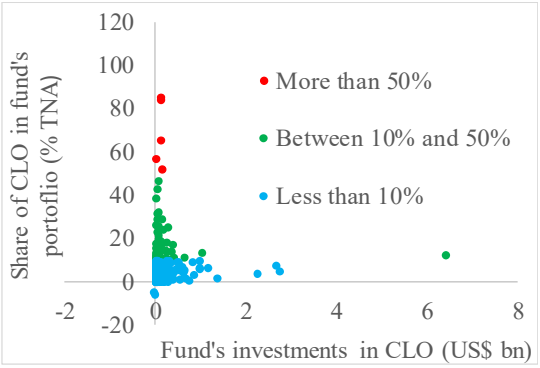
By comparison, open-ended funds' exposure to CLOs may not pose material systemic risks for two reasons. First, most of the open-ended funds' exposures to CLOs belong to funds with small investments in CLOs. At end-2019, US$47 bn worth of CLOs (or 78% of US$60 bn investments in CLOs by open-ended funds) were held by funds that had less than 10% of their assets in CLOs (represented by the blue marks in Chart 6). While there are a few open-ended funds with more than half of their portfolios invested in CLOs (represented by the red marks in Chart 6), their total investments in value terms are small at US$0.5 bn. Taken together it suggests the chances of a CLO sell-off by these funds and the potential impact on the CLO price may not be systemic. Secondly, an estimated 82% of CLOs held by open-ended funds were rated A or better, suggesting that the chance of losses due to defaults in the underlying LLs should also be small.[11]

Chart 5: LLs price decline in March-2020



Note: Price of LLs is represented by S&P Global Leveraged Loan Price Index, which measure the performance of the global leveraged loan market. It is 75% weighted in the S&P/LSTA Leveraged Loan Index (which measures of performance LLs in the US) and 25% weighted in the S&P European Leveraged Loan Index.
Source: Bloomberg

Chart 6: CLOs investments by open-ended funds



Notes: (1) The scatter plot depicts the exposures of CLOs by open-ended funds measured in share to fund's assets (% of TNA) against the funds measured in value terms (US$ bn). (2) The red / green / blue marks denote those with more than 50% / between 10% and 50% / less than 10% of fund's TNA in CLOs respectively. (3) Positions at the end of 2019.
Source: Morningstar and authors' estimates

Taken together these findings, **although the aggregate exposures of open-ended funds to LLs and CLOs remained limited, as shown during the March-2020 episode fire sales by a small number of LL funds could generate a downward spiral in LL prices and sharp fund outflows, causing financial**

[11] Position at the end of 2019. For each CLO, we map its corresponding credit rating as provided by Dealogic whenever available by matching the CLO's name and coupon rate. While we can only identify the credit rating for about one-third of the open-ended funds' CLO holdings, the estimated figure is similar to an estimate on the quality of CLOs held by open-ended funds in the US (GAO, 2020)

stability concerns. In view of this, our empirical analysis focuses on LL funds to better understand their risks and the implications for the overall LL market.

IV. HOW SIGNIFICANT IS THE LIQUIDITY RISK FACED BY LL FUNDS? WHICH FACTORS MAY AMPLIFY THE LIQUIDITY RISK?[12]

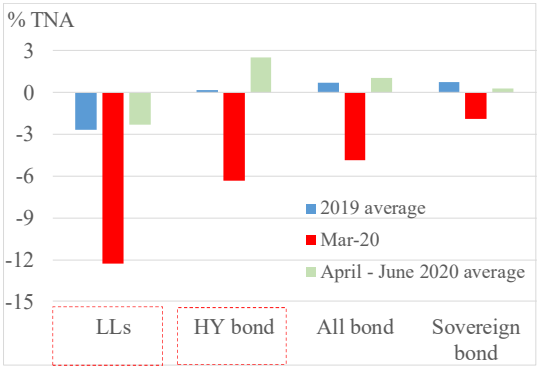
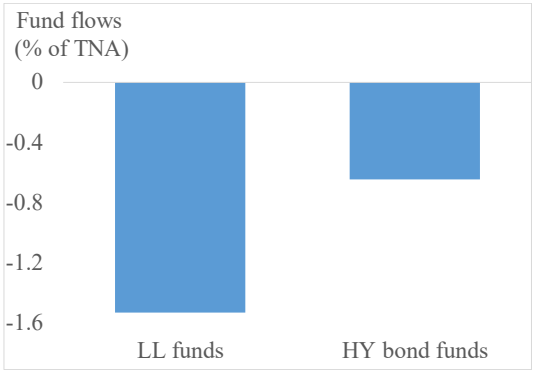
4.1 How significant is the liquidity risk faced by LL funds?

We find considerable liquidity risk in LL funds. Based on EPFR data, Chart 7 shows that during the March-2020 episode, LL funds experienced notably larger outflows of 12.6% (of total net assets, or US$15 bn) in the month, compared to other risky assets such as HY bond funds' (6.5%), amid a sharp fall in the price of LLs (Chart 5).

Our empirical analysis shows further that, even after controlling for fund performance, the liquidity risk of LL funds is still high compared with that of HY bond funds. Chart 8 shows that during times of stress (defined as periods where the VIX index is higher than the 90th percentile of sample), a one percentage point (ppt) drop in funds' return would lead to an outflow of funds by 1.5 ppts for LL funds, much higher than the estimate of 0.7 ppts for HY bond funds.[13] This suggests that for the same shock to LL prices and HY bond prices (which affect the returns of LL funds and HY bond funds respectively), the liquidity risks to LL funds will increase by a much larger extent than HY bond funds.

The high liquidity risk found in LL funds may reflect investors' concerns about the high liquidation costs of LLs. During times of stress, LL funds may have to sell their LL holdings at a much discounted price to meet liquidity demands from investors. This substantially dilutes the funds' values. In anticipation of this, investors of LL funds may take first-mover advantage and redeem ahead of others to avoid material losses. The large redemption pressures then result in the significant liquidity risk in LL funds. While the adverse impact of first-mover advantage may be common for many open-ended funds (including HY bond funds), the impact for LL funds may be particularly large given the low credit quality and illiquid nature of LLs.

[12] The empirical results reported in this section are robust to including open-ended funds that have average share of LLs above 50% over-time (instead of end-2019), or including also open-ended funds that are defined as loan fund by Morningstar (but have less than 50% of assets in LLs at end-2019).
[13] The finding holds for other periods but the differences are smaller. See Table C.1 for details.

Chart 7: Outflows from open-ended funds during the March-2020 episode	Chart 8: Response of fund flows to fund performance during times of stress
	
Note; The classifications of funds are based on source. Source: EPFR.	Notes: (1) This chart depicts the estimated effect of a one ppt decline in fund return on outflows from LL fund and HY bond fund during times of stress, defined as periods where the VIX index is higher than the 90th percentile of the sample. (2) The solid shades denote the estimated impact is statistically significant at a 10% level. (3) The differences in the estimated impacts for LL funds and HY bond funds are statistically significant at 10% level (see the second-last row of Table C.1). Source: Authors' estimates.

4.2 Which factors may amplify the liquidity risk of LL funds?

We further find that LL funds' holding of LLs are **highly pro-cyclical, and they hold significant common LLs, which could amplify their liquidity risk. Leverage of LL funds, however, may not be a significant factor in amplifying the risk.** Detailed assessments are shown below.

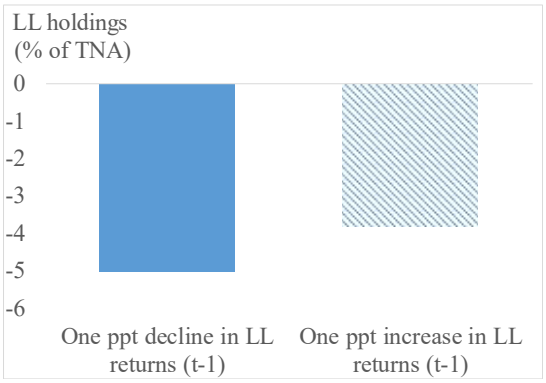
Pro-cyclicality

Our results show that LL funds' holdings of LLs are highly pro-cyclical, i.e. a decline in the LL price will accelerate the selling of their LLs holdings to meet investors' redemptions. Our empirical analysis shows that after controlling for the amount of LL funds' outflows, a fall of one ppt in LL returns (the month-to-month percentage change in LL prices) in the previous month would trigger a significant reduction of 5 ppts in their LL holdings in the current month (the left bar of Chart 9).[14]

[14] This is in stark contrast with the avoidance to sell LL holdings when the LL prices rose (right part of Chart 9, with a statistically insignificant estimate) where LL funds would instead use other sources of liquidity (e.g. cash buffer or selling other assets) to meet investors' redemptions.

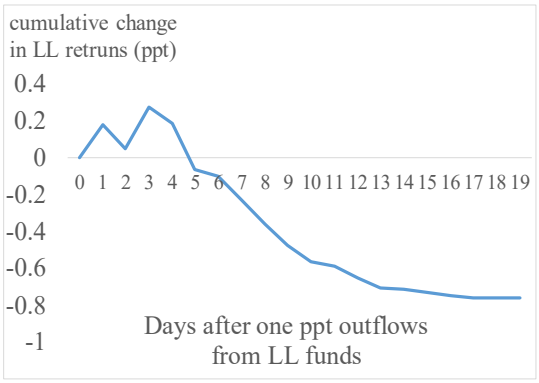
The sell-off of LL holdings in this situation could weigh on the already declining LL prices. A simple impulse response estimate shows that a one ppt outflow from the LL funds (which results in a reduction in LL holdings) could lead to a cumulative decline of 0.8 ppts in LL returns in a month (Chart 10). **As a result, the sell-off of LL holdings and decline in LL prices could reinforce each other and result in a downward spiral.** This amplifies the liquidity risk in LL funds.

Chart 9: Estimated impact of LL returns on LL holdings by LL funds



Notes: (1) This chart depicts the estimated impact of a one ppt change in LL price (in previous month) on the change in LL holdings by LL funds in current month, after controlling for the amout of outflows in previous month. (2) Solid shade denotes the estimated impact is statistically significant at a 10% level.
Source: Authors' estimates.

Chart 10: Effect of LL fund flows on LL returns

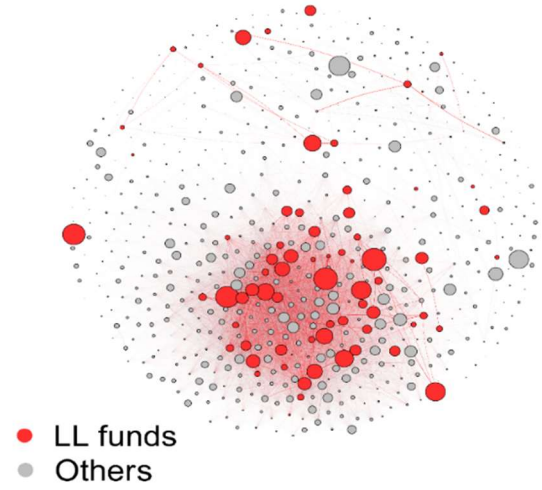


Note: This chart depicts the impulse response estimate for the cumulative effect (up to 20 trading days) of a one ppt decline in aggregate LL funds' flows on LL returns. It is estimated using a simple vector-autoregressive (VAR) model that includes LL returns and aggregate LL funds' flows as endogeneous variables.
Source: Authors' estimates.

Commonality in holdings of LLs

The LL funds are found to be highly connected because they hold significant common LLs. This can be seen in the network diagram (Chart 11), which shows that in December 2019, LL funds (represented by the red nodes) mostly cluster together with strong linkages via their large common holdings of LLs (represented by the darker red lines between red nodes). Such strong linkages may trigger a collective market response (e.g. fire sales of LLs) to shocks to the LL market.

Chart 11: Commonality of LLs holdings in LL funds

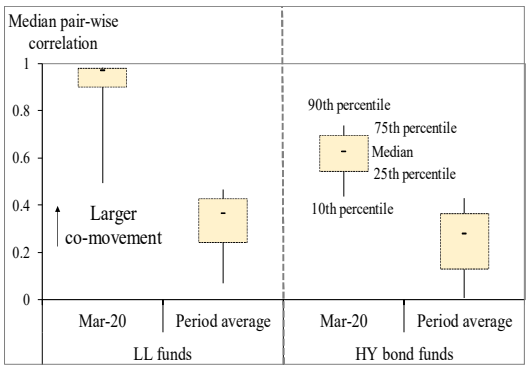
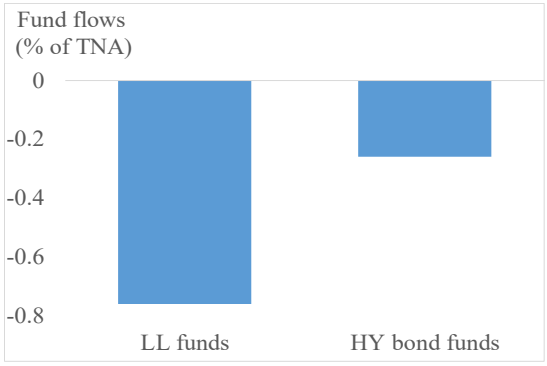


Notes (1) This chart depicts the common holdings of LLs between open-ended funds, where red nodes indicate the LL funds while grey nodes indicate other open-ended funds with exposures to LLs. 2) The node size is proportional to an open-ended funds' LLs holdings in value terms. 3) The line connecting any pair of nodes (fund) represent their interconnectedness with respect to common LL holdings (at borrower-level and as % of their total net assets), with connections involving any LL fund (either with another LL fund or other open-ended funds) in red, while connections involving other open-ended funds only in grey. A darker line (red or grey) between a particular pair of funds indicates more common LL holdings, and thereby larger interconnections between them.
Source: Morningstar and authors' estimates.

Given these strong linkages, the LL funds display a noticeable co-movement in fund returns in March-2020. Specifically, the median correlation of LL funds' returns was exceptionally high at 0.97 during that month (see the first box plot of Chart 12), comparing to the estimate of 0.4 for the overall period. Also, the estimate for LL funds during the stress period is found to be higher than the corresponding estimate for HY bond funds (i.e., 0.6 in March 2020, the third box plot in Chart 12).

The stronger co-movement in returns also makes LL funds move strongly in tandem with their close peers (defined as the other LL funds with a high correlation in fund returns).[15] Empirically, an aggregate one ppt net outflow from the close peers (as compared to the average flows of all LL funds) would be associated with an outflow of 0.8 ppts from a LL fund (left part of Chart 13), other things being equal.[16] **This implies that a shock to LLs could quickly spread through LL funds through their common holdings of LLs and expose a wider group of LL funds to liquidity risk.**

[15] For each LL fund "i", we define another LL fund "y" as its close peer if the correlation of its returns (with LL fund "i") ranks above the 75th percentile among all other LL funds (with fund "i").
[16] Applying the same analysis to HY bond funds, we find that their relationship with close peers is significantly weaker at 0.3 percentage points (right part of Chart 13).

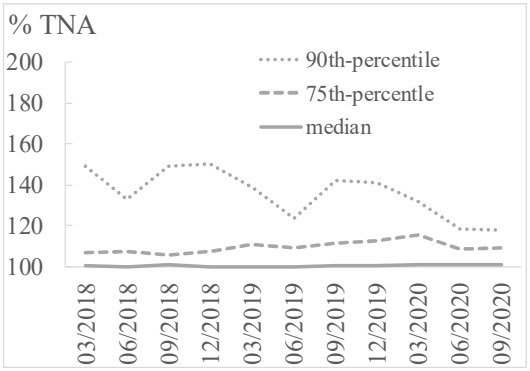
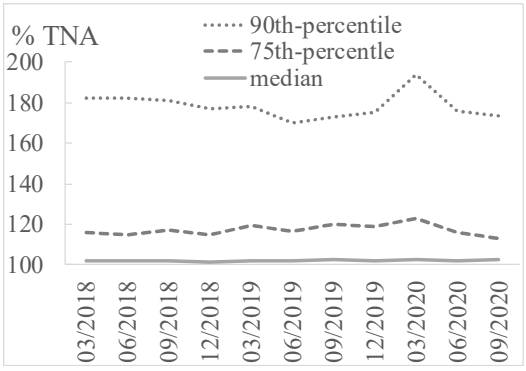
Chart 12: Estimated relationship between the flows of LL funds and their close peers	Chart 13: Estimated relationship between the flows of LL funds and their close peers
	
Notes: (1) The box plots depict the distribution of return correlation of funds within the fund group, a more positive correlation denotes larger co-movement in fund returns. (2) For LL fund (HY bond funds), the flow correlation refers to the median value of correlation between its daily fund return and that of each other LL fund (HY bond fund). Source: Authors' estimates.	Notes: (1) This chart depicts the estimated relationship between aggregate one ppt net outflow from close peers (defined as the average flows of close peers substracting the average flows of all LL or HY bond funds) on the flows of a LL fund or HY bond fund in the same month. (2) Solid shade denotes the estimated impact is statistically significant at a 10% level. Source: Authors' estimates.

Leverage

We find that most LL funds employed little leverage during the sample period, making it unlikely to be a significant factor in affecting their liquidity risk. Chart 14 depicts the distribution of the long leverage ratio across LL funds over the past few years. The long leverage ratio is a commonly used measure of fund leverage and is defined as the ratio of total "long" exposure to fund's TNA (Avalos et al, 2015).[17] During the period, half the LL funds employed almost no leverage (as reflected by the median line which is very close to 100%), and three-quarters of them employed less than 10% leverage (see the 75th-percentile line).[18] While considerable leverage was observed in LL funds at the high-end (see the 90th-percentile line), there was a declining trend in the level as well. It was also considerably lower than that of their counterparts in the HY bond funds (Chart 15). All these suggest that the fund leverage is less likely to amplify the liquidity risk in LL funds.

[17] We also calculate gross leverage ratio (ratio of funds' total long and short positions to total net assets) as an alternative and it reveals a similar picture to the long leverage one's. Note that both ratios are subject to limitation. The long leverage ratio may understate fund leverage as short positions are not considered (Avalos et al, 2015). On the other hand, gross leverage would overstate economic exposure as it treats the short and long positions as independent sources of revenue, while in many cases they are part of a single bet and tend to hedge each other.

[18] A value of 100% means zero fund leverage, where funds do not borrow (which will be recorded as short position) or engage in other short positions via derivatives.

Chart 14: Leverage in LL funds	Chart 15: Leverage in HY bond funds
	

Note: (1) Figures refer to the "long" leverage of funds, defined as the ratio of total "long" exposure to net asset value. (2) A higher value denotes larger leverage, while a value of 100% means zero leverage.
Source: Morningstar and authors' estimates

V. CONCLUSION AND IMPLICATIONS

By examining the portfolios of open-ended funds that invested in LLs or CLOs around the world, this study finds that although the aggregate exposures to these assets remained a limited part of their total assets and only a smaller number of them invested heavily in LLs, fire-sales of LLs by such a small portion of LL funds could generate a downward spiral in LL prices and sharp fund outflows, as demonstrated during the March-2020 episode.

Our empirical analysis shows further that the fire-sales of LLs may mainly stem from the liquidity risk of LL funds, which is high even when compared with that of HY bond funds. We also find that LL funds' holding of LLs are highly pro-cyclical, and they hold significant common LLs, which could amplify their liquidity risk. Leverage of LL funds, however, may not be a significant factor in amplifying the risk.

Looking ahead, given the rising issuance of LLs[19] and the continued search-for-yield by investors amid the abundant global liquidity conditions, open-ended funds' exposure to LLs could increase further. These developments call for close monitoring and policy to address the risks identified by this study. To this end, this study concludes with two policy implications:

i. Bridging the data gaps to monitor the holdings of LLs by banks and non-bank financial institutions is important, as the identification of

[19] During the first half of 2021, issuance of LLs in the U.S. (average US$ 208 bn per quarter) is 70% higher than the pre-pandemic level, See PricewaterhouseCoopers "Q2 2021 Capital Markets Watch"

common exposures plays a key role in assessing the potential spillover risks.

ii. Given the large liquidity risk facing LL funds and the potential spillovers to the financial system, policy to strengthen LL funds' liquidity management (e.g. lowering the dealing frequency and requiring a higher buffer of liquid assets) [20] may help address the root cause of vulnerabilities, while additional limits on leverage may be less effective.

[20] By lower dealing frequency (from daily to bi-monthly or even monthly), investors can only redeem on specified dates (e.g., every 15th and 30th day of a month for bi-monthly dealing) instead of any day (for daily dealing), allowing more time for open-ended funds to arrange liquidity (e.g. sell underlying assets) to meet investors' redemption requests and reduce potential liquidity mismatch.

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Annex

A: Further details on the features of LLs

Some common definitions on LLs include loans (i) to borrowers whose gross debt to EBITDA ratio is four times or higher; (ii) to speculative grade (i.e. below BBB) borrowers; (iii) to finance an acquisition (e.g. management buy-out (MBO) or leveraged buy-out (LBO)); or (iv) with a high spread at issuance (e.g. +125 basis points)

Table A.1: Comparison of LLs and HY bonds

Asset	LLs	HY bonds
Coupons	Floating-rate	Typically fixed coupons
Recovery rate	Collateralized, senior secured debt and at the top of corporate capital structure	Subordinate in corporate capital structure and paid after LLs
Callability	Callable at par after the first few months of issuance which could limit the upside potential to investors	Better call protection to allow investors to benefit from price appreciation
Liquidity	Less liquid with longer settlement time	More liquid
Investor protection	Borrowers are required to follow the loan agreement on what to do and not to do. However, it is observed that investor protection have been weakening in recent years (largely due to investors more willing to forgo such protections for better returns)	No such restriction
Transparency	Less transparency and less regulated	More disclosures from corporates

Source: Banegas and Goldenring (2019)

B: Morningstar data on investment funds exposures to LL and CLOs

Data on investment funds' holdings in LLs and CLOs are sourced from Morningstar, which provides monthly data on the breakdown of funds' assets by type (e.g. bond, equity, expressed as % of fund assets). Funds' exposure to LLs and CLO are based on the share of funds' assets in bank loans (equivalent to LLs in this study) and CLOs respectively.[21] A total of 7377 funds with investments in either LLs or CLOs (as at the end of 2019) are identified, including 6148 open-ended funds (or 83% of total fund count), 1013 insurance product fund (or 14% of total fund count), 157 close-end funds (or 2% of total fund count) and 59 exchange traded fund (or 1% of total fund count).

Analysis on the commonality of LL holdings by LL funds (i.e. Chart 11) is based on security-level fund holding provided by Morningstar, including loan-level LL holdings information. The loan-level information includes borrower name, coupon, currency and maturity. For each pair of open-ended funds, we measure common LL holdings by the amount of loans (issued by particular borrowers) that are held by two funds at the same time.

C: Technical details of regression analysis

This annex covers the technical details on various empirical analyses discussed in Section 4. Generally speaking, various panel data regression models are applied in deriving the reported estimates. The panel regression model used in each case is described below:

LL funds' liquidity risk (Chart 8)

The following model is considered for the effect of fund return decline on LL fund and HY bond fund flows during times of stress;

$$flow_{i,t} = \alpha + \beta_{LL} return_{i,t-1} * D + \beta_{HY} return_{i,t-1} * (1 - D) + \sum_{k=2}^{K} \beta_k \, Control_{k,t-1} + \epsilon_i + \theta_t + \varepsilon_{i,t} \quad (1)$$

Where *flow* is fund flow (% change in fund assets net of return), *return* is the fund return. *Control* is a set of control variables that include fund *size* and *age*. ϵ_i and θ_t denote fund and time-fixed effect respectively. Finally, *D* is a dummy variable that equals 1 for LL fund and zero for an HY bond fund. The variables of interest are β_{LL} and β_{HY} under this set-up, which denotes the effect of fund return on the flow of LL fund and HY bond fund respectively, conditional on the specified data sample. Column 1 of Table C.1 reports the estimation results.

Table C.1: Estimation effects of fund return and market condition on LL fund flows

	$flow_{i,t}$	
	(1)	(2)
$return_{i,t-1}$ | D=1	**1.53*** **	**0.95*** **
$return_{i,t-1}$ | D=0	**0.65** **	**0.37*** **
$Size_{i,t-1}$	**-59.01*** **	**-3.41*** **
$Age_{i,t-1}$	/	-0.24
Fund-fixed effects	Yes	Yes
Time-fixed effects	Yes	Yes
Number of observations	1311	11077

[21] Morningstar reckons most bank loans held within investment portfolios are typically referred to as LLs because the balance sheets of their borrowers carry heavy debt burdens.

Number of funds	738	1185
Dummy definition	D = 1 (0) for LL (HY bond) funds	
$return_{i,t-1}$ | D=1 -$return_{i,t-1}$ | D=0	**0.88****	**0.58*****
Sample	Vix > 90th percentile & $return_{i,t-1}$ < 0	$return_{i,t-1}$ < 0

Note: ***, ** and * denote statistical significance at 1, 5 and 10% respectively.

Pro-cyclicality (Chart 9)

The following model is considered for the effect LL returns on LL holdings;

$$dLL_{i,t} = \alpha + \beta_{flow} flow_{i,t-1} + \beta_{pos} LLreturn_{i,t-1} * (1 - Dfl) + \beta_{neg} LLreturn_{i,t-1} * (Dfl) + \sum_{k=2}^{K} \beta_k Control_{k,t-1} + \epsilon_i + \theta_t + \varepsilon_{i,t} \quad (3)$$

where the *flow* and *Control* defined in the same way as Equation (1). *dLL* is the real change in LL holdings (change in nominal LL holdings net of LL price change) while $LLreturn_{i,t-1}$ denotes the LL returns (month-to-month percentage change in LL prices) in previous period. *Dfl* is a dummy variable that equals one if $LLreturn_{i,t-1}$ is negative (i.e. a decline in LL price) and zero otherwise (i.e an increase in LL price). By including only observations with negative $flow_{i,t-1}$, β_{neg} (β_{pos}) denotes the effect of 1% decline (rise) in LL price on LL funds' LL holdings, given an outflow from LL fund in previous month. Table C.2 reports the estimation results.

Table C.2: Estimated impact of LL return on funds' LL holdings

	$dLL_{i,t}$
$flow_{i,t-1}$	0.08
$LLreturn_{i,t-1}$ | D=1	**5.01****
$LLreturn_{i,t-1}$ | D=0	-3.83
$Size_{i,t-1}$	**-2.43*****
$Age_{i,t-1}$	-0.59
Fund-fixed effects	Yes
Time-fixed effects	Yes
Number of observations	1455
Number of funds	72
Dummy definition	D = 1 (0) for negative (positive) $LLprice_{i,t-1}$
Sample	$flow_{i,t-1}$<0

Interconnectedness (Chart 13)

To estimate the relationship between outflows from a LL fund / HY bond fund and outflows from its close peers, Equation 3 below is considered;

$$flow_{i,t} = \alpha + \beta_1 return_{i,t-1} + \beta_{sLL} peerflow_{i,t} * D + \beta_{sHY} peerflow_{i,t} * (1 - D) + \sum_{k=2}^{K} \beta_k Control_{k,t-1} + \epsilon_i + \theta_t + \varepsilon_{i,t} \quad (3)$$

where the *flow*, *return*, *Control* defined in the same way as Equation (1). *peerflow* is the net flows for close peers, defined as average flows of the quartile of LL (HY bond) funds with highest daily return correlation (in previous month) with LL (HY bond) fund subtracting the average flows of all LL (HY bond) funds. *D* is a dummy variable that equals one for LL funds and zero for HY bond funds. By including only observations with negative $peerflow$, β_{sLL} (β_{SHY}) denote the

relationship of between flows of LL fund (HY bond fund) and net outflows from its close peers. Table C.3 reports the estimation results.

Table C.3: Estimated effects of peer fund flows on LL fund flows

	$flow_{i,t}$
$return_{i,t-1}$	**0.31*** **
$peerflow_{i,t}$ | D=1	**0.76*** **
$peerflow_{i,t}$ | D=0	**0.26***
$Size_{i,t-1}$	**-2.27*** **
$Age_{i,t-1}$	-0.01
Fund-fixed effects	Yes
Time-fixed effects	Yes
Number of observations	18855
Number of funds	1214
Dummy definition	D = 1 (0) for LL (HY bond) funds
Peer fund group	Fund correlation over 75p
Sample	$peerflow_{i,t}$<0
$return_{i,t-1}$ | D=1 -$return_{i,t-1}$ | D=0	**0.49***

Note: ***, ** and * denote statistical significance at 1, 5 and 10% respectively.