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Zusatztext und Abstracts der kumulativen Dissertation

Three Essays on the Leveraged Loan Market

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Overview

This dissertation comprises three essays on the leveraged loan market. Each essay addresses a separate topic concerning secondary trading in this private debt market. In contrast to traditional security markets such as the stock or bond market, which have been academically investigated for many years or even decades, the leveraged loan market is rather unexplored despite its size and importance for the global financial system. Thus, the aim of this work is to shed light on important and fundamental aspects with respect to trading these risky private debt instruments.

First of all, what actually is a leveraged loan? Leveraged loans constitute the high-risk part of the broad syndicated loan universe. These credit facilities are essential in financing risky firms. A syndicated loan is a source of external funds issued to a single borrower by a group of lenders. This group of borrowers forms the so-call loan syndicate. Typically, one or several banks (commercial as well as investment banks) are responsible for structuring, administering and arranging the loan. Hence, these banks are commonly known as arrangers. To monitor the borrower and as determined in the loan agreement, the syndicate receives material borrower-specific information which must not be made public. Today, a syndicated loan usually comprises different loan tranches: the pro rata tranches and the institutional tranches. The pro rata tranches typically consist of revolving credit lines and amortizing loan facilities, the so-called term loans A. These loan facilities are majorly syndicated to banks. The second category comprises the institutional tranches, which, as the name already implies, are typically syndicated to (non-bank) institutional investors. This tranche comprises first and second lien term loans (term loans B, term loans C, etc.). Institutional loan facilities have longer maturities, pay higher interest rate margins, and amortize either small installments prior to and the remaining balance at maturity, or repay the entire notional amount in one (“bullet”) payment at expiration (for further details on loan structuring, see Standard & Poor’s, 2013; Taylor and Sansone, 2007, among many others).

Today, the syndicated loan market is of tremendous size. Globally, the Bank of England estimated a total volume of more than \$2.2 trillion of leveraged loans outstanding at the end of 2018 of which around \$1.8 trillion is held by non-bank institutional investors.¹ Starting with the leveraged buyout activity of the 1980s, the syndicated loan market has experienced a strong upswing. Such corporate takeovers require a large amount of funds, why the loan size, and hence, riskiness and required risk-compensation increased as well. The need of banks to share the risk of these large loans, the rise in interest rates and the attractive risk-return profile called the attention of non-bank institutional

¹See <https://www.bankofengland.co.uk/bank-overground/2019/how-large-is-the-leveraged-loan-market> for more details.

investors. That is, the characteristics of leveraged loans make participating in this market interesting for institutional investors. More precisely, leveraged loans are typically senior and secured corporate debt instruments that pay floating interest rates, and the amortization schedule can specify smaller but regular repayments already before the end of the loan contract. Taking all these characteristics together, leveraged loans offer proper consideration of credit and interest rate risk. A high-yield bond is another fixed-income instrument and can be considered as security pendant to the leveraged loan. In contrast, however, bonds are usually subordinate, unsecured and pay a fixed coupon, and thus, have a riskier profile than loans. For that reason, the leveraged loan market became an attractive investment class among alternative institutional investors, such as collateralized loan obligations (CLOs), loan mutual funds, credit hedge funds, pension funds, insurance companies, and others. With the appearance of such non-bank institutional investors, secondary leveraged loan trading experienced tremendous growth and reached an all-time high of \$743 billion in 2019² (see Standard & Poor’s, 2013; Taylor and Sansone, 2007).

Despite the large number and diversity of loan investors, secondary trading usually takes place over-the-counter with the arranging banks acting as dealers, because the loan product and its trading process is of rather complex nature. In addition, loans are not securities and hence, there is no certain authority that regulates the market. For that reason, the Loan Syndications and Trading Association (LSTA) was established to set up and monitor trading standards. This standardized documentation and the launch of mark-to-market pricing services strengthened secondary market liquidity, which is essential for loan investors to set up portfolio management tools (see, e.g., Wittenberg-Moerman (2008), Beyhaghi and Ehsani (2017), and Addoum and Murfin (2020) for comprehensive summaries, and Standard & Poor’s (2013) and Taylor and Sansone (2007), among others, for extensive details on leveraged loans and the syndicated loan market.)

However, what is market liquidity? Although there is no unambiguous definition, market liquidity may comprehensively be delineated as the capability to trade an asset at a price close to its fundamental value without moving the price, and the time between contract conclusion and settlement is short (see, e.g., Pástor and Stambaugh, 2003). Sarr and Lybek (2002) describes liquidity by means of five characteristics: (i) tightness represents trading costs, (ii) immediacy describes the speed with which an asset is transferred, (iii) depth characterizes the number of traders, (iv) breadth represents the price impact of incoming orders, and (v) resilience is related to the ability of a market to absorb order imbalances. Despite the growth and maturing of the secondary loan market, it remains, however, an opaque market due to its limited pre- and post-trade transparency. In addi-

²See the Loan Syndications and Trading Association (LSTA) report at <https://www.lsta.org/news-resources/lsta-secondary-trading-2019-executive-summary>.

tion, the members of the loan syndicate receive material borrower-specific information via the borrower-lender communication channel, which must not be publicly disseminated. Thus, there is considerable potential for adverse selection in the secondary loan market by the very nature of corporate loans as private debt instruments.

Motivated by the potential asymmetric information issues for loan trades, the first essay *Trading costs of private debt* addresses the probably most prominent measure of liquidity: the trading costs. The aim of this study is to shed light on the question, how expensive is it actually to trade leveraged loans and what are the determinants and sources of secondary market trading costs. This empirical work combines realized trade and dealer quote data to estimate leveraged loan trading costs. Trade data is collected from realized transactions of CLOs, the most important loan investor group. The daily quoted loan prices at the facility level are obtained from Markit, a mark-to-market pricing service that gathers and averages the posted quotes from dealers which make the market in the respective loan facility.

In a first step, the essay explores the time-variation of loan market liquidity. The primary objective is to investigate how market liquidity is affected by dealer funding constraints (e.g., Brunnermeier and Pedersen, 2009; Gârleanu and Pedersen, 2007; Gromb and Vayanos, 2002), and order imbalances induced by loan investors (e.g., Campbell et al., 1993). For this purpose, four time series models are applied by regressing the bid-ask spread of four liquidity indices on loan market returns to account for capital constraints, mutual loan fund in- and outflows to proxy for order imbalances, and further control variables. Using this set up, it is possible to disentangle the supply and demand effect on liquidity. This time series analysis shows two asymmetric effects. First, market downturns decrease liquidity more than market upturns increase liquidity, which supports the capital constraints paradigm. Negative loan price returns, i.e., a decline in collateral values increases funding costs and tightens capital constraints which makes it more expensive for dealers to supply liquidity. In addition, the analysis also finds evidence that dealers demand higher compensation for absorbing order imbalances induced by the liquidity demand of loan investors. More precisely, excessive loan fund share redemption forces the managers to sell assets. In turn, market makers require higher spreads to accommodate the fund managers' selling pressure. On the other hand, liquidity demand through excess buy orders does not seem to significantly affect the general market liquidity.

Next, panel regressions are conducted to investigate the determinants of loan trading costs. The expenses of executing a loan trade is estimated by means of the so-called effective half-spread. This measure is calculated as the difference between the transaction price and the fair value of the facility. As it is common in market microstructure theory, the facility's fundamental value is proxied by the dealers' posted midquotes, i.e., the

midpoint between the quoted bid and ask price. In general, even compared to its nearest relative, the high-yield bonds, loans are expensive to trade with an average effective half-spread of 47.6 basis points. To investigate the cross-sectional trading cost variation, the effective half-spreads are regressed on several facility and trade characteristics to examine two main theories of market microstructure, the inventory holding costs and adverse selection paradigm (see Demsetz, 1968; Stoll, 1978; Ho and Stoll, 1981; Glosten and Milgrom, 1985). The results find support for both theories as, e.g., price return volatility and past price movements, bid-ask spreads, dealer competition, facility size, and trading volume are significantly correlated with transaction costs.

As mentioned before, adverse selection, which is one source of illiquidity, is assumably large in an opaque market with significant presence of private information. Therefore, transaction costs are decomposed into two components: the temporary price impact and the permanent price impact. While the temporary price impact can be seen as dealer profit to process the trade, the permanent price impact measures the enduring pressure on prices exercised by informed trading. The empirical results confirm the initial conjecture as adverse selection costs on average account for around two thirds of the effective half-spread. The cross-sectional analysis identifies small trades in large and volatile facilities with extreme past price movements to be informed. On the other hand, dealer rents are higher the lower the dealer competition and the smaller the facility's notional amount.

Finally, the essay investigates if and how liquidity is priced in loan returns, or more precisely, in yield spreads. Asset pricing models state that expected returns increase with transaction costs and the systematic variation of liquidity (e.g., see the overview in Amihud et al., 2005). To test this theory in the leveraged loan market, facility yield spreads are regressed on trading costs and a proxy for the time-variation of a borrower's default risk. After controlling for credit risk, the regression results find a significant negative relation between liquidity and yield spreads, however, borrower default risk remains the principal risk factor that is priced.

Although loan trading involves considerable trading costs, the secondary market is well-established and shows vital trading activity. Like in the stock market, loan managers actively balance their portfolios according to their risk-return profile. Thus, volatility modeling and predicting became a mandatory task in both asset management, e.g., in the context of portfolio selection (Markowitz, 1952), and in the field of risk management, e.g., for best-possible value-at-risk or expected shortfall estimation (see, e.g., Andersen et al., 2006, among many others). Hence, volatility estimation should be of particular interest for loan portfolio managers, just as for, e.g., stock portfolio managers. For this purpose, the second essay *Forecasting leveraged loan market volatility using GARCH models* evaluates several volatility modeling approaches with respect to their out-of-sample predictive

ability of estimating leveraged loan return volatility. The essay thus contributes to the volatility literature by evaluating the capacity of volatility models in the loan market. The focus on out-of-sample predictive power is based on the quasi compulsory requirement on forecasting models to not only perform well in-sample, but especially to predict the respective measure accurately out-of-sample.

It is meanwhile well-known that, firstly, volatility rather appears in clusters than being constant over time (Mandelbrot, 1963), and secondly, volatility asymmetrically reacts to news (Black, 1976). More precisely, this means that (i) there are periods with low volatility and there are periods with high volatility, and (ii) good news tend to decrease volatility, whereas bad news tend to increase volatility. Introduced in the seminal papers of Engle (1982) and Bollerslev (1986), generalized autoregressive conditional heteroskedasticity (GARCH) models have become a prominent class of models to estimate the time-variation of volatility. However, although these models are very sophisticated, complexity does not necessarily outperform simplicity (see the overview in, e.g., Poon and Granger, 2003). Thus, the second essay evaluates and compares various GARCH-type models with comparably simple but widely used historical approaches, the simple moving average (SMA) and exponentially weighted moving average (EWMA) method.

The essay applies a wide range of evaluation and comparison methods. More precisely, the volatility models are assessed by means of a regression-based approach (Mincer and Zarnowitz, 1969), loss functions (MSE and QLIKE), and statistical tests, namely the Diebold-Mariano test (Diebold and Mariano, 1995) and the model confidence set test (Hansen et al., 2011). The analysis does not only straightforwardly apply the prognosis models, it additionally investigates whether the enrichment of the models with related market volatility measures improves the predictive accuracy. More precisely, the GARCH models are extended by the following stock, bond and loan volatility proxies: (i) the Chicago Board Options Exchange (CBOE) volatility index (VIX), (ii) the ICE BofAML U.S. Bond Market Option Volatility Estimate Index (MOVE), and (iii) the LCD Loan Volatility Metric (LVM).

The results show that ARMA-GARCH models are suitable to estimate the time-variation of loan return volatility. Within the GARCH framework, models that account for the negative return-volatility correlation and heavier tailed error distributions predict future volatility better than symmetric approaches. In addition, GARCH models basically outperform the simple historical volatility models, however, the superiority is statistically insignificant. The final insight is that related market volatility measures carry some informational content that is not captured by the GARCH framework. In this study, the inclusion of volatility proxies into the conditional variance equation marginally improves the forecasting power of GARCH models.

The findings from the previous two essays pave the way to the third essay. First, the selection procedure of the conditional mean equation (i.e., the ARMA process) in the GARCH analysis indicates that loan returns exhibit a certain degree of autocorrelation. This finding, together with the asymmetric information issue from the transaction costs analysis, and considering the characteristics of the leveraged loan market as private debt market naturally translates into the question concerning the efficient market hypothesis of Fama (1970). According to this fundamental theory, prices are informationally efficient if they fully and correctly reflect all available information. However, already the partially large order of autocorrelation in the return mean equation seems to contradict this hypothesis. Thus, the third essay *On the efficiency of the leveraged loan market* investigates whether the leveraged loan market is efficient and how does the level of efficiency evolve over time.

In the first part, the automatic variance ratio test of Choi (1999) is applied to evaluate whether the leveraged loan market as a whole is informationally efficient. The test is applied to the broad U.S. leveraged loan index and to four capitalization- and risk-based sub-indices. For all loan composites, the test rejects the hypothesis of informational efficiency. In the second part, the adjusted market inefficiency magnitude of Tran and Leirvik (2019) is used to answer the question, how does the level of inefficiency evolve over time. This analysis broadly supports the insights from the variance ratio tests. Although there is some time-variation, the market exhibits strong levels of inefficiency.

Trading costs of private debt

Andreas Keßler

Thomas Mählmann

Abstract

In this paper, we use institutional trade and dealer quote data to estimate transaction costs in the over-the-counter leveraged loan market. While loans are expensive to trade with average effective and quoted half-spreads of 47.6 bps and 41.4 bps, respectively, temporal and cross-sectional variation in liquidity is large. We relate this variation to factors suggested by theories of market microstructure. In the time-series, we find an asymmetric response of transaction costs to loan market returns: negative market returns increase costs much more than positive returns decrease them. This finding is consistent with the predictions in the collateral-based models of liquidity supply. In the cross-section, our results support the inventory holding costs and adverse selection paradigms of price formation. As expected for a market without the governance role of securities laws and any regulatory oversight, the level of informed trading is high. In particular, about two thirds of the average effective spread represent adverse selection costs, and only one third compensates the liquidity provider for inventory holding or order processing costs. Finally, we disentangle liquidity and credit risk non-parametrically, and find that liquidity is marginally priced in secondary market loan spreads, as predicted by classic asset pricing theory.

JEL classification: G11; G14; G23

Keywords: Private markets; Leveraged loans; Trading costs; Institutional investors

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Forecasting leveraged loan market volatility using GARCH models

Andreas Keßler

Abstract

This paper compares different GARCH models in terms of their out-of-sample predictive ability of leveraged loan market volatility. The study investigates whether the asymmetric effects of good and bad news on volatility is present and how distributional assumptions affect the selection of GARCH models. Compared to two widely used historical volatility models, the simple moving average and the exponentially weighted moving average, the results suggest that asymmetric GARCH models have marginally better out-of-sample predictive ability. In addition, this study finds that fixed income market volatilities improve the forecasts of loan market volatility. The model comparison involves a regression-based approach, loss functions and statistical tests.

JEL classification: C32; C53; G17

Keywords: Private markets; Leveraged loans; GARCH; Volatility forecasting

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On the efficiency of the leveraged loan market

Andreas Keßler

Abstract

This paper evaluates the informational efficiency of the leverage loan market. First, variance ratio tests are conducted to answer the question whether this private debt market as a whole is efficient. Second, the recently developed adjusted market inefficiency magnitude is applied to assess the level of market inefficiency over time. The results indicate that the broad leveraged loan market, as well as capitalization- and risk-based sub-indices exhibit large levels of inefficiency and that loan returns do not follow a random walk but are significantly serially correlated. The degree of inefficiency shows some time-variation, however, it is generally large in magnitude.

JEL classification: G14, D47

Keywords: Private markets; Leveraged loans; Market efficiency

Keßler, A., 2021, On the efficiency of the leveraged loan market, Working Paper.

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