The impact of order flow on event study returns: New evidence from zero-leverage firms

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Abstract

We empirically examine the initial loan announcement period of 96 zero-leverage firms listed on the FTSE 350 index. Our research demonstrates that there is a clear tendency that trades are executed at the ask price during the initial loan announcement period, which are regarded as favorable firm-level news. Similar results are observed for subsamples formed on the basis of trade size. Order flow disruption causes a bias in the calculation of returns around the company event announcement.

JEL Classification: G14; G15

Key words: Order flow ratio; Liquidity; Bid-ask spread; Bid-ask bounce.

1. Introduction

Over the last 20 years, there has been evidence that the existing bid-ask bias and order flow imbalance interact with stock return. Bid-ask bounce means that the price of a stock bounces rapidly forth and back within the very limited range between the bid price and ask price. The bid-ask bias is a possible explanation for return anomalies as return reversals might simply be a shift from transactions at bid prices to transactions at ask prices. Most of previous studies (e.g.: Gregoriou, 2008; Alzahrani et al., 2013) on order flow imbalance focus on block trading, which are minimum trade size of 10,000 shares. They discover that a temporal imbalance between buy and sell orders relate with the informed traders who are trading based on the private information. Buyer-initiated trades have a stronger price impact than seller-initiated trades, and this asymmetry has been attributed to higher informed trading in purchases than in sells. As a result of these, stocks prices and further orders react accordingly. Lo and Coggins (2006) indicate that order flow conveys information beyond trading volume. Gosnell et al. (1996) state that order flow imbalances are instantly transparent with buying pressure being significantly greater during the positive news announcement period.

Our primary objective is to obtain the empirical evidence of buy-sell order imbalances and return anomalies during the initial loan announcement period of zero-leverage firms. According to Strebulaev and Yang (2013), a zero-leverage firm is defined as a company that does not possess any short or long-term debt. Zero-leverage firms occupy an important position in the market. Strebulaev and Yang (2013) find in the U.S., an average 10.2% of large public firms follow zero-leverage policy during 1962 to 2009, and there are almost 22% firms that keep less than 5% book leverage ratio. Dang (2013) discovers in the UK financial market, more than 12.8% of firms operate a zero-leverage policy between 1980 and 2007. Ghoul et al. (2018) report that the percentage of zero-leverage firms in 2010 (17%) has approximately doubled

from 1990 (8%). Bessler et al. (2013) conclude that most zero-leverage firms are less profitable, have a higher level of return volatility, are smaller and younger than other levered firms. They suffer from credit restrictions and therefore financial constraints. Hadlock and Pierce (2010) report that the low or zero leverage firm which has short history and small market chaptalization suffers more from adverse selection and information asymmetry. Therefore, they prefer to build up their reputation in credit markets by borrowing and repaying from banks. The announcement of an initial bank loan is a unique event in the financial market because it contains information about the first time that a zero-leverage firm encounters a debt. Zhang and Gregoriou (2019a) observe an improvement of liquidity and positive market reaction when zero-leverage firms are issued their initial bank loan. The stock price goes up whereas bid-ask spread goes down, while the level of liquidity is improved overall. If order flow disruption occurs on the initial loan announcement date, this could provide an explanation of abnormal stock trading activities around the initial loan announcement.

To our knowledge, this is the first empirical study that examines the order flow ratio of zero-leverage firms during the initial loan announcement. Most of previous studies (e.g.: Gregoriou, 2008; Alzahrani et al., 2013) on order flow imbalance focus on block trades, which are minimum trade size of 10,000 shares. It is not clear whether similar results hold for zero-leverage firms or any other small or infrequently traded stocks. We begin with the empirical analysis by computing both the transaction price return and mid-point price return of zero-leverage firms around the initial loan announcement date. We then explore the placement of a trade within the bid-ask spread by measuring the order flow ratio, for all trades and small, large trade groups. Finally, we examine the relationship between order flow ratio and transaction price-based, mid-point-based returns. We attempt to answer the question does the order imbalance provide the explanation of abnormal return of zero-leverage firms during the initial

loan announcement period, and how the different trade size responds to the news which is reflected by the order flow imbalance and return bias.

Our paper also makes a contribution on the analysis of the position of trades within the spread around the corporate event announcement. Blume et al. (1989) and Lease et al. (1991) examine the relationship between order flow imbalance and stock return during the bad news announcement period. In contrast, in our research the initial loan announcement can be regarded as a favourable event. It could indicate that the order flow imbalance causes buying or selling pressure around the initial loan announcement of zero-leverage firms. According to Zhang and Gregoriou (2019a), adopting debt for the first time causes a positive reaction in market value of the firms, decreasing the bid-ask spread and the stock market volatility. This is because bank lending activities certify firm quality and signal credit worthiness to outside investors. As bid-ask spread size is one of the sources of stock return errors, any changes in the bid-ask spread will cause the changes of bid-ask error automatically. If the spread is minimal, the bid-ask bounce becomes unnoticeable. Therefore, the volatility of spread during the announcement period creates a favourable environment for detecting the bid-ask bias.

In addition, we provide evidence on the difference between closing price return and mid-point based returns, and the relationship between them and the order flow imbalance ratio around the initial loan announcement. The bid-ask spread widens for zero-leverage firms' stock (Zhang and Gregoriou, 2019a). Therefore, the bid-ask bounce which is caused by trades taking place at the bid or ask quotes as opposed to the midpoint should be more influential. As the stock returns are computed based on transaction prices, the statistically significant profits may not be economically realized. In order to mitigate the influence of shifts between the bid and

the ask price, we measure stock returns using the midpoints rather than the closing transaction prices.

One of the other contributions of our study is the size of our sample. Most previous research analyzes order flow imbalances concentrating on a short time period, for example, Alzahrani et al. (2013) examine the imbalance between purchases and sales in the Saudi stock market for almost 4 years. Levi and Zhang (2015) analyze the changes of buyer and seller initiated orders around the event announcement during 26 months. Our data span is significantly longer than previous studies. We investigate the event of zero-leverage firms traded on the London Stock Exchange (LSE) over a 16-year time period. Moreover, our sample firms are significantly larger than previous studies, 96 zero-leverage firms listed on the FTSE 350 across many different industries. The prior research, for example, Hasbrouck and Seppi (2001) and Brown et al. (1997) study order imbalances for thirty and twenty stocks, over one and two years, respectively. Furthermore, the LSE allow us to identify the exact trading direction without referring to any trade identification algorithms, such as the Lee and Ready (1991) rule, which would inevitably introduce some estimation errors.

The remainder of the paper is organized in the following way. In the next section we provide a review of the previous literature. Section 3 discusses the data collection, section 4 describes the methodology used. Section 5 reports the empirical analysis of the stock market reaction of bank loan announcements of zero-leverage firm. Finally, section 6 concludes our findings.

2. Literature review

When the zero-leverage firms decide to lever up, bank loans will be their first choice since they need to establish a good credit history and reduce their costs of public debt. Berger and Udell (1995) believe that the process of the bank issuing an initial loan to a zero-leverage borrower can reduce information asymmetry problems. The transactions give banks the opportunity to gather a vast amount of information on their borrowers at minimum costs. Financial intermediation hypothesis believes that banks are able to examine potential borrowers more effectively than the public as they have access to private information about the companies (Lummer and McConnel, 1989). Zhang and Gregoriou (2019a) find that the initial loan announcement results in overall improvement of liquidity and sends a positive signal to the market. The signaling effect of initial loan announcement to the market causes a positive market reaction. It produces superior information which can resolve information asymmetry in the market and this is reflected by reduction in the bid-ask spread.

A company announcement event can result in a movement of closing prices toward either the bid (a predominance of sell orders) or the ask quote (a majority of buy orders), and it can be measured by order flow ratio. Gosnell et al. (1996) reveal that order flow is significantly imbalanced around the news announcements. For bad news in their research, the transaction price location shifts towards a dominance of sell orders immediately after the announcement, and the imbalance in the order flow ratio last in the long term. Therefore, as the favourable corporate event, the announcement of initial loan will attract more buyer-initialled orders and the transaction price location should shift towards a dominance of buy orders. Moreover, Lee (1992) finds that during the post-announcement period, there is no difference between the number of large buy and sell orders, but there is a significant increase in the volume of small buy and sell orders. Zhang and Gregoriou (2019b) examine the price behavior of zero-leverage firms after the initial loan announcement. They observe that the buy order has a greater impact

on price changes, once price effects are estimated using quote returns to eliminate the bid-ask bias, the asymmetry effects between buy and sell orders are dramatically decreased. Bissoondoyal-Bheenick et al. (2019) show that the effect of seller/buyer-initiated trades on bad/good volatility is asymmetric, the effect of seller-initiated trades on bad volatility is consistently larger than that of buyer-initiated trades on good volatility. On the other hand, Kim and Stoll (2014) examine the relation between informed trading and order imbalance around the announcement event. Order imbalances do have price effects, but there is little evidence that the order imbalance is significantly correlated with the forthcoming announcements.

Chordia et al. (2019) discover that the volatility of order imbalance can be a measurement of information asymmetry cost. An increase in volatility of order flow imbalance is associated with greater adverse selection cost. Huang et al. (2020) report that the volatility in order imbalance works well in representing the costs of information asymmetry when trading against informed institutional investors in the Taiwan stock market. Zhang et al. (2019) demonstrates that in the Chinese stock market, the daily order imbalances are highly persistent, but the price pressure caused by imbalances cannot last beyond a trading day. This suggests that China's stock market is efficient enough to absorb the imbalances.

Kaul and Nimalendran (1990) find that the bid-ask error component of transaction returns can explain over 50% of daily return variances, resulting in excess volatility and price reversals in the short term. Therefore, return series constructed using bid, ask, or the average of bid-ask prices could result in more reliable inferences. Lease et al. (1991) use both transaction-price-based returns to examine possible trading profits and quote-midpoint-based returns to evaluate equilibrium prices movements. They demonstrate that the bid-ask bounce explains a significant proportion of the excess negative returns earned on seasoned equity offerings. If closing prices

just prior to the announcement accept at the bid price while closing prices after the announcement accept at the ask price, then an additional bid-ask bounce bias would be introduced. Gosnell et al. (1996) believe that due to randomness bouncing between the bid and ask prices, the closing-price return has a higher volatility than that of quote price or the mid-point return. A spurious gain or loss caused by trades moving away from the bid-ask midpoint. This gain or loss is later reversed as transactions resume at the bid-ask midpoint. Han and Lesmond (2011) argue that the bid-ask bounce inherent a liquidity bias, the price movement is not a "true" price movement, but that it nevertheless increases the volatility of stock returns and consequently price reversal. Lo and Coggins (2006) maintain that the degree of return reversal is positively related to the level of order flow imbalance. Chordia and Subrahmanyam (2004) find that there is a positive relation between order imbalances and returns. Blume et al. (1989) find that the relevance between order flow imbalance and return is much stronger for large firms such as the firms listed on the S&P 500 index. They experience a much greater decrease in price because large firms suffer more from excess selling pressure.

3. Data

3.1 Firm data

Our dataset records the zero-leverage firms listed on the FTSE 350, that have their first bank loan announcement between 1 January 2000 and 31 December 2015[1]. The data are collected from Thomson Reuters Eikon, a worldscope fundamental financial database. The FTSE 350 firm is defined as the aggregation of the FTSE 100 and FTSE 250 index listed firms, which consists of the 350 largest firms listed on the LSE with respect to market capitalization.

[1] We require that firms are not financial companies, utility companies or closed-end mutual fund. The stock has enough data from 2000 to 2015, including trade volume, average daily price, daily closing price, and bid-ask spread.

The FTSE 350 represents around 89% of the entire trading volume on the LSE, enabling us to obtain a very accurate description of the UK stock market.

For each company we obtain the average closing price, bid price and ask price, trading volume (number of stocks traded), and market valuation (total share outstanding multiple by share price) at the month prior to the announcement. We also collect information concerning the initial loan undertaken by the firm including the issue date and loan amount. This enables us to calculate the loan amount to total assets ratio. In total, there are 96 zero-leverage firms within the FTSE 350 over our sample period that have sufficient data for our study during the period. The frequency of the zero-leverage adoptions of loan debt by year can be seen in the appendix.

Panel A of Table 1 presents the firm-level information of zero-leverage firms. The zero-leverage firms are smaller than leveraged firms, as we predicted, the spreads of zero-leverage firms are higher than the firms with debt. Lease et al. (1991), believe that the order flow bias is larger for stocks of smaller firms or with high price variability, since the bid-ask spread, as a percentage of price, is larger for such stocks. Especially when returns are computed with transaction prices.

3.2 Trading data

Panel C presents the trades analyzed in our research. The LSE identifies a trade as a purchase or a sale on their database. The overall sample consists of 28,342,080 buy orders and 26,101,600 sell orders, which is substantially larger when compared with previous research studies. We then examine the buy and sell orders by the trade size. We use a share-based proxy following Gregoriou (2008) and most of the previous studies, with small trades defined as the

trade size less than 10,000 shares and the large trades as greater than 10,000 research (block trades). In our study, the buy and sell orders for the small trade subgroup is 16,880,654 and 11,030,300 respectively, whereas for large trades, the buyer-initialled orders are 11,461,426 and 15,071,300 for seller-initialled orders. Following Gregoriou (2008) among others, small (large) trades are defined as transactions of less (more) than 10,000 shares.

[INSERT TABLE 1 HERE]

4. Methodology

4.1 Order flow ratio

Lo and Coggins (2006) define the net order flow as the difference between buyer-and seller-initiated trading volumes. We follow Lease et al. (1991) and Gregoriou (2008), by computing the within-spread location of the closing price for each zero-leverage firms' stock *i* for each event day *t* as:

$$\text{Order flow ratio} = \frac{(\text{ask} - \text{price})}{(\text{ask} - \text{bid})} \quad (1)$$

We assume that buyers purchase at the ask price where sellers trade at the bid price. As Lease et al. (1991) mentioned, the nearer order flow ratio is to 1, the more likely the transaction price is at the bid quote, indicating the selling pressure. While the closer this ratio is to 0 the greater the likelihood the trade is at the ask, an indication of buying pressure.

4.2 Event Return around the initial loan announcement

In general, we use the standard market model method for both transaction price based return and midpoint quote based return. We estimate the abnormal returns by using an economically market-adjusted model:

$$AR_{i,t}=R_{i,t}-R_{m,t} \quad (2)$$

Where $AR_{i,t}$ is the abnormal return earned by stock i at time t. $R_{i,t}$ is the return on stock i at time t, and $R_{m,t}$ is the value-weighted market index return at time t. As a proxy for the market's return, we use the FTSE index returns for the sample period. The announcement date (day 0) is the day of the initial bank loan announcement. In terms of the short-term period, we examine abnormal returns (AR) for the announcement day [day 0], three-day period around the announcement day [-1, +1], five-day period around the announcement day [−2, +2] and eleven-day period [-5, +5] around the announcement day. We calculate the long event period as long as 181 days [-90, +90] around the announcement day.

As we have discussed in section 2, in an attempt to eliminate the return biases which are induced by order flow imbalances, we calculate the return based on midpoint price as well.

$$AR'_{i,t}=R'_{i,t}-R_{m,t} \quad (3)$$

We have defined R as returns calculated using closing prices, now we introduce R' as returns calculated using the midpoint price. R contains pricing errors due to the bid-ask spreads. R', however, is constructed using only the midpoint price suggesting that it will not be under the influence of the bid-ask spread errors. We can thus construct tests to evaluate both the R and R' and obtain a direct estimate of the relative importance of asymmetric price impact and bid-ask errors.

Cumulative abnormal return (*CAR*) of the event window can be calculated using the following formulas:

$$CAR_{i,t(-q,+q)}=\sum_{t=q}^{s} AR_{i,t} \quad (4)$$

$$CAR'_{i,t(-q,+q)}=\sum_{t=q}^{s} AR'_{i,t} \quad (5)$$

Where q is equals to 1, 2, 5, 10, 20,.....90 respectively, represents the different time period during the event window. The standard t-test is used to test whether the $AR_{i,t}$, $CAR_{i,t}$, $AR'_{i,t}$, and $CAR'_{i,}$ differ significantly from zero.

4.3 Financial Returns and order flow ratios

We use the ordinary least squares method to obtain the cross-sectional variables of both closing price and midpoint returns for zero-leverage firms around the initial loan announcement period. Specifically, the regression takes the following forms:

$$R_{i,t}=\mu_0+\mu_1 Initial_{i,t}+\mu_2 O_{i,t}+\mu_3 Vol_{i,t}+\mu_4 Size_{i,t}+\mu_5 StdDev_{i,t}+\mu_6 Price_{i,t}+\mu_7 LA_{i,t}+\varepsilon_{i,t} \quad (6)$$

$$R_{i,t}'=\mu_0+\mu_1 Initial_{i,t}+\mu_2 O_{i,t}+\mu_3 Vol_{i,t}+\mu_4 Size_{i,t}+\mu_5 StdDev_{i,t}+\mu_6 Price_{i,t}+\mu_7 LA_{i,t}+\varepsilon_{i,t} \quad (7)$$

Where $t=1$ corresponds to the pre-announcement period and $t=2$ corresponds to the post-announcement period. The subscript i means 96 initial loan announcement of zero-leverage sample firms in our research. The dependent variables, R and R' is the closing price-based return and midpoint-based return, for stock i at time t, respectively. Independent variables include $O_{i,t}$ which is the order flow ratio for stock i at time t. $Initial_{i,t}$, defined as the dummy variables which is equal to one if the trading occurs after the initial loan announcements

otherwise it is equal to zero. $Vol_{i,t}$ is the natural logarithm of the average daily volume of trading in stock i at time t, $Size_{i,t}$ is the natural logarithm of the market capitalization of zero-leverage firm i at time t, $StdDev_{i,t}$ is the natural logarithm of the stock prices' standard deviation, which captures the volatility in the true price for stock i at time t. $Price_{i,t}$ is the natural logarithm of the daily average share price of stock i at time t, and $L/A_{i,t}$ is the natural logarithm of the loan amounts to total assets ratio. All the firm-level variables are computed from one month before the announcement. We are primarily interested in the coefficient of $O_{i,t}$, which we predict should have a negative relationship with stock returns.

5. Empirical Results

5.1 The price effects associated with initial bank loan

First, in order to examine the effects of initial loan announcement on the zero-leverage firms stock price, we measure the abnormal return based on both the closing price and midpoint price. We observe the estimation results in Table 2, the effect of the initial loan announcement on the zero-leverage firms is significantly positive from the pre-announcement period. For stock return calculated by closing price, the abnormal returns are positive from 60 days prior to the announcement date, indicating the possibility of information leakage before the loan announcement. The abnormal returns achieve the peak at the event date, 2.394, and are statistically significant. In the event day +1, the abnormal return is 1.645 with a t-test equal to 10.14. During the 5 day (-2, +2) and 11 day (-5, +5) period around the announcement date, the cumulative return is 6.400 and 9.005 respectively.

Panel B of Table 2 reproduces the event study in Panel A using daily abnormal returns calculated from the midpoint quote between the bid and ask price. There is clear evidence that the bid-ask effects and order flow ratio have some implications on the stock markets. On the

initial loan announcement date, we observe an abnormal return of 2.365 percentage (t-statistic of 12.84), and in the first trading day after announcement, the abnormal return is 1.870 (t-statistic of 9.13). During the post-announcement period for midpoint-based abnormal return, we observe relatively larger positive returns than transaction-based returns. The average cumulative abnormal return of 4.868 is observed over the 3-event day interval [-1, +1], with a highly significant t-value. Event windows [-2, +2] and [-5, +5] have CARs of 7.193 and 9.564 respectively which are both highly significant. According to Lease et al. (1991), it can be concluded that after the firm-level favorable news announcements, the market participants start to increase their inventory level in the zero-leverage firm's stock. Overall, whether we use the quote midpoint or closing price-based estimate of returns we observe the positive abnormal return after the initial loan announcement. The results indicate that using an alternative return method to isolate the microstructure bias, causes the same direction results with the different magnitude. After we purged the bias due to the bid-ask bounce, the remaining loan announcement returns are still positive, which could be caused by the positive news and the liquidity effect.

[INSERT TABLE 2 HERE]

5.2 Trades tendency and order flow ratio

Table 3 presents the percentage of closing price occurring at the ask, bid and at the midpoint for the 181-day event window. After the initial loan has been announced, the tendency of closing prices to be at the ask price are highly significant. The percentage of closing transaction prices occurring at the ask quote are larger than at the bid quote from 30 days before the announcement date. In the event day, the percentage of closing prices occurring at the ask quote and bid quote is 42.58 and 30.70 respectively. This indicates that there is a decrease in sell orders and an increase in buy orders on the day of the initial loan announcement. Buy

orders are related with some good news rather than bad news. Large one-day price increases are occurring on the announcement day. These are likely to be associated with substantial buying pressure, enhancing the probability that a closing transaction is at the ask price and leading to a continuation during the next day. We obtain similar findings for small trades (Panel B) and large trades (Panel C). On the announcement day for small trades 43.60% of trades occur at the ask price and 33.89% of trades are at the bid price. For large trades, 49.25% of trades are at the ask price and 37.17% of trades are at the bid price. In the one day after the announcement, 44.06% and 48.96% of trades occur at the ask quote for the small and large trades group respectively, while 33.06% and 36.99% are at the bid quote. Our results are consistent with Chan and Lakonishok (1993) who mention that buying a stock is associated with favorable firm-specific news, since it reflects the choice of one specific security out of many.

The last column of Table 3 presents the order flow ratio. We calculate the average ratio of (ask-close)/(ask-bid) for the individual stocks on each event day surrounding the initial loan announcement. In Panel A, on the announcement date, the mean ratio decreases from 45.13 on day -1 to 41.66 and continues to be smaller than 0.5 (nearer to 0) during the post-announcement period. For small trades in Panel B, the mean ratio in our event period is generally smaller than 0.5, indicating that the traders tend to buy shares with small volume. However, in Panel C (large trades) 10 days prior to the announcement the order flow ratio is 51.16, indicating more sell orders than buy orders. According to Lee (1992), the order flow imbalance before the news announcement can be regarded as a measurement of the information leakage, as it measures how quickly market participants adapt to the news. In our study, the large traders respond to the news from 1 day before the announcement whereas the small traders' react on the announcement day.

Comparing the order flow ratio between small and large trades, large traders are associated with stronger trading reactions. This is because the high buying activities concentrate more around the announcement day. For example, the 3-day period during the announcement for large trades is 42.03, 40.18 and 40.97, whereas for small trades in Panel B it is 45.33, 43.26 and 42.04 respectively. The response of large trades is more dramatic than the small trades, and the reactions of small traders are slower than the large traders. The statistical test shows these results (the order flow imbalance) are significantly different from both the pre-and post-announcement period based on the *t*-test at the 1% significance level. It indicates that after the initial loan announcement, buy orders are much larger than the sell orders, and it does not subside during the short term. Following the initial loan of zero-leverage firm announcement, stock market buying increases, creating an upward trend in closing prices and daily returns.

[INSERT TABLE 3 HERE]

5.3 Financial returns and firm characteristics

We apply the regression method in order to address the order flow imbalance that may be evident in the relation between stock returns and initial loan announcement. Table 4 reports that the closing price-based returns have a strong negative correlation with the order flow ratio. This is reflected by the coefficient of -0.057 with a t-statistic of -4.69. As we have previously mentioned, the nearer this ratio is to 0, the more likely the closing price is at the ask price. The negative coefficients between order flow ratio and stock returns indicate that the more likely the trades will be executed at the ask price, the larger return of stocks. For mid-point returns which are based on the midpoint price, the coefficient is -0.042 with a t-statistic equal to -2.14, which is slightly smaller than the closing-based return, a 1% decrease of order flow ratio is

associated with an increase of 4.2% in the average mid-point price-based returns. It implies that when we purged the bid-ask bias by measuring the return by midpoint, the negative association between order flow and stock returns still exist. But the magnitude of coefficient implies the correlation between order flow ratio and mid-point-based returns is smaller than the correlation between order flow ratio and closing price returns.

The findings for small and large trade subsamples are in the Panel B and C respectively. For small trades, the coefficient between order flow and closing price returns is -0.011 with a t-statistics of -1.69, for mid-point-based returns, the coefficient is -0.010 with a t-statistic of -1.58. There are no significant differences between closing price-based return and the mid-point price return. In Panel C, the coefficients of order flow variables are significant for large trades, -0.106 (t-value =-5.43) for closing price return and -0.094 (t-value=-3.68) for mid-point returns. Also the large traders show a more pronounced difference between price-based returns and quote-based returns.

The results also suggest that the dummy variable representing initial loan announcements appears to have a positive relationship with both the closing price-based and mid-point-based return. It indicates that the initial loan announcement has a positive influence on the stock return, even after controlling for the order flow ratio. However, the results for mid-quote returns are generally less significant than the transaction-based return, suggesting that when we purged the bid-ask bias and controlling other firm-level variables, the stock has little reaction to the initial loan announcement. Moreover, the results show that the coefficients of the standard deviation which measures the volatility of midpoint return are smaller than the closing-price based return (-0.012 for closing price return whereas -0.001 for midpoint price return). Confirming the results of Han and Lesmond (2011) and many other researchers,

closing price-based idiosyncratic volatility is usually larger than that of the quote midpoint-based volatility.

[INSERT TABLE 4 HERE]

5.4 Robustness test

After the measurement of stock return by both transaction price return and midpoint return, we employ the ask-to-ask return, and bid-to-bid return for robustness in Table 5. Overall, the asymmetry within the quote price return always exists regardless of the event announcements. For example, during the event day the abnormal returns based on ask price is 2.883 whereas the bid price return is 2.315. On the first trading day after the announcement, the abnormal return is 2.129 for ask price return whereas it is 1.233 for bid price return. According to Zhang and Gregoriou (2019a), the buy order is motivated by both the information and liquidity factors before the initial loan announcement. Market makers trade according to their requirements based on both private information and liquidity. During the announcement period, the favorable firm-level news attracts more buy orders leading to the liquidity increasing, resulting in low bid-ask spread. The ask-to-ask abnormal returns in Table 5 are larger than bid-to-bid returns. These effects are permanent because the increasing liquidity persists in the long-term.

[INSERT TABLE 5 HERE]

6. Conclusion

In this paper we empirically examine the initial loan announcement period of 96 zero-leverage firms listed on the FTSE 350 index. Our research demonstrates that there is a clear tendency that trades are executed at the ask price during the initial loan announcement period, which are regarded as favorable firm-level news. Order flow disruption causes a bias in the calculation of returns around the company event announcement. Buying pressure affects the stock performance during the event period, reflected by the price increases and spreads

decrease. Small traders respond differently from large traders to the same information signals. Large trades respond to the news quickly whereas the small trades show a puzzling reaction during the announcement. The empirical evidence shows that the order flow imbalance does not subside during the short term in the post-announcement period. Furthermore, the order flow ratio is negatively related to the stock return. As the order flow ratio goes towards zero, this is related with more buy orders, causing the price and return to increase. Our estimation process is based on a large sample with approximate 28 million share purchases and 26 million share sells, over the time of period 2000 to 2015. These phenomena may explain several significant event study results that have been documented in recent years. It shows that the stock market liquidity reacts strongly when a bank reports favorable news via the announcement of the initial loan agreement. We conclude that the order flow imbalance can explain part of bid-ask spread bias and asymmetry, in the trading direction of zero-leverage firms when they encounter debt for the first time.

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Appendix: The frequency of the zero-leverage adoptions of loan debt by year

Year	Frequency
2000	28
2001	6
2002	7
2003	12
2004	11
2005	3
2006	5
2007	4
2008	4
2009	0
2010	2
2011	5
2012	2
2013	3
2014	2
2015	2

Table 1. Descriptive Statistics

Table 1 presents the summary statistics of 96 zero-leverage firms listed on the FTSE 350 that undertook an initial loan during the time period of 2000-2015. Panel A provides the descriptive statistics on borrower firms. Market capitalization is calculated as the natural logarithm of the firm's market capitalization measured by pounds. Absolute spread is defined as ask price minus bid price. Relative spread is defined as ask price minus bid price, then divided by quote midpoint. Effective spread is defined as two times trade price minus quote midpoint. The midpoint is ask price minus bid price divided by two. Panel B provides the disclosed amount to be borrowed by the zero-leverage firm measured in pounds. Panel C presents the purchases and sales of sample firms for the period, including the total, small and large trades. We define the small trades as the trade size smaller than 10,000 stocks and the large trades as the trades size of more than 10,000 shares.

PANEL A: BORROWER DESCRIPTIVE STATISTICS

	Zero-leverage firm	**All firm**
Market Capitalization (£000,000)	3995	4231
Stock Price(£)	507.633	523.435
Standard deviation of return (%)	1.250	1.231
Trading Volume	6,325, 000	6,520,000
Absolute Spread	2.537	2.031
Relative Spread (%)	0.015	0.011
Effective Spread (%)	0.412	0.369

PANEL B: LOAN DESCRIPTIVE STATISTICS

	Mean (£000,000)	Median (£000,000)	Std.Dev	Min (£000,000)	Max (£000,000)	Skewness
Initial Loan	1537.29	248.92	7916.28	44.88	69049	7.94

PANEL C:ORDER-INITIAL BY TRADING VOLUME

	Total	Small trades	Large Trades
Buys	28,342,080	16,880,654	11,461,426
Sells	26.101.600	11030300	15071300

Table 2. The Price Effect Associated with Initial Bank Loan of Zero-leverage Firm

Table 2 provides the daily average returns (AR) from the pre-announcement to the post-announcement period calculated by closing-price (Panel A) and midpoint price (Panel B), which provides the bid-ask bias purged return. The sample consists of 96 zero-leverage firms listed on the FTSE 350 that undertook an initial bank loan during the time period of 2000-2015. T-statistics are presented to show if sample loans' AR are significantly different from zero. Event day (day zero) presents the day of the bank loan announcement. Two tailed tests of significance are reported as follows, ***less than 1%, **less than 5% and * less than 10%.

Event Day	**Panel A: Closing price returns(N=96)**		**Panel B: Midpoint returns (N=96)**	
	AR (%)	**T-stat**	**AR (%)**	**T-stat**
(-90,0)	0.167	1.72*	0.103	1.79*
(-80,0)	0.212	2.60**	0.000	1.92*
(-70,0)	-0.327	-3.57**	-0.024	-2.83**
(-60,0)	0.519	5.46***	0.445	2.34**
(-50,0)	0.392	4.08***	0.288	2.77**
(-40,0)	0.273	2.86**	0.269	1.69*
(-30,0)	0.256	2.67**	0.244	2.43**
(-20,0)	0.135	1.43*	0.120	1.96*
(-10,0)	0.167	1.56*	0.031	0.95
-5	0.268	2.78**	0.028	0.79
-4	0.196	2.08*	0.177	1.91*
-3	0.103	1.14	0.214	2.26**
-2	0.449	4.27***	0.417	3.93***
-1	0.517	4.99***	0.633	5.98***
0	2.394	12.20***	2.365	12.84***
1	1.645	10.14***	1.870	9.13***
2	1.395	9.73***	1.908	9.25***
3	0.816	7.49***	1.000	8.97***
4	0.657	5.92***	0.734	6.88***
5	0.565	5.69***	0.518	5.28***
(-1, +1)	4.556	16.06***	4.868	14.99***
(-2, +2)	6.400	17.55***	7.193	16.87***
(-5,+5)	9.005	19.37***	9.564	18.73***
(0,10)	0.258	2.25**	0.297	2.41**
(0,20)	0.428	3.91***	0.490	3.94***
(0,30)	0.152	1.58*	0.233	2.59**
(0.40)	0.161	1.74*	0.258	8.27***
(0,50)	0.170	1.76*	0.186	1.98*
(0,60)	0.151	1.52*	0.174	1.77*
(0,70)	0.319	2.99**	0.481	4.18***
(0,80)	0.167	1.43*	0.198	1.77*
(0,90)	0.155	1.32	0.243	2.66**

Table 3. Closing Prices relative to Bid and Ask Quotes surrounding the Initial Loan Announcement Date of Zero-leverage Firms.

Table 3 reports the event day relative to the announcement day (day 0), the percentage distribution of closing prices in relation to the bid and ask quotes, and order flow ratios for the 96 FTSE 350 listed zero-leverage firms that undertook an initial bank loan during the time period of 2000-2015. The results for all trades are reported in Panel A, the small and large trades results are shown in Panel B and Panel C respectively. The order flow ratio is calculated as (ask price-trading price)/(ask price – bid price). Two tailed tests of significance are reported as follows, ***less than 1%, **less than 5% and * less than 10%.

PANEL A: ALL TRADES

	Distribution of Closing Prices		
DAY	**At ask**	**At bid**	**Order flow ratio**
-90	29.80	37.64	53.06
-60	30.66	34.65	51.06
-30	39.22	34.89	48.91
-10	39.67	37.59	49.28
-5	34.34	31.81	48.69
-4	38.22	32.96	48.33
-3	41.01	35.27	47.01
-2	39.67	34.90	47.29
-1	36.66	29.74	45.13
0	42.58	30.70	41.66
1	42.34	31.41	41.97
2	41.66	31.62	42.00
3	40.08	29.02	41.78
4	39.87	30.61	43.26
5	40.69	31.72	43.93
10	37.34	31.01	46.09
30	37.66	31.12	45.24
60	37.07	31.87	47.24
90	36.01	30.90	47.25
	Panel A: Test of mean order flow ratio on Day 0 to the Comparison period		
		Pre-announcement period	Post-announcement period
T-TEST		4.88***	9.74***

PANEL B: SMALL TRADES

	Distribution of Closing Prices		
DAY	**At ask**	**At bid**	**Order flow ratio**
-90	34.24	30.23	49.17
-60	36.48	30.65	48.32
-30	36.93	31.69	48.96
-10	37.26	31.61	48.45
-5	35.77	29.74	48.53
-4	39.64	32.85	47.66
-3	40.66	33.62	47.28
-2	40.01	32.02	46.59
-1	37.49	30.23	45.33
0	43.60	33.89	43.26
1	44.06	33.06	42.04
2	45.78	36.52	43.58
3	44.63	34.74	43.16
4	43.53	32.90	42.97
5	44.71	33.68	42.04
10	42.78	33.74	43.63
30	40.69	31.92	44.29
60	38.86	30.78	46.47
90	37.43	29.14	46.04
	Panel B: Test of mean order flow ratio on Day 0 to the Comparison period		
		Pre-announcement period	Post-announcement period
T-TEST		3.14**	6.88***

PANEL C: LARGE TRADES

	Distribution of Closing Prices		
DAY	**At ask**	**At bid**	**Order flow ratio**
-90	30.06	38.51	54.65
-60	31.24	37.32	53.24
-30	37.85	37.73	50.00
-10	37.64	34.54	51.16
-5	39.03	36.97	49.37
-4	39.99	33.70	48.94
-3	41.80	34.71	46.01
-2	42.93	35.29	45.68
-1	43.11	33.12	42.03
0	49.25	37.17	40.18
1	48.96	36.99	40.97
2	48.27	37.42	41.04
3	47.95	35.00	40.13
4	46.44	36.80	44.21
5	40.08	31.11	44.56
10	39.04	32.19	47.48
30	39.85	32.85	46.96
60	38.37	31.59	48.24
90	38.24	31.74	48.38
	Panel C: Test of mean order flow ratio on Day 0 to the Comparison period		
		Pre-announcement period	Post-announcement period
T-TEST		4.96^{***}	11.03^{***}

Table 4. Regression between Transaction Returns and Firm Variables by Quote Price Effects

Table 4 reports the relationship between stock return and firm-level variables, for 96 zero-leverage firms in FTSE 350 index, over the period from 1 January 2000 to 31 December 2015, for both closing price-based return *R* and mid-quote-based return *R'*. Panel A reports the results for all trades, the findings of small and large trades are shown in panel B and C respectively. The regression models estimated are the following:

$$R_{i,t}=\mu_0+\mu_1 Initial_{i,t}+\mu_2 O_{i,t}+\mu_3 Vol_{i,t}+\mu_4 Size_{i,t}+\mu_5 StdDev_{i,t}+\mu_6 Price_{i,t}+\mu_7 LA_{i,t}+\varepsilon_{i,t}$$
$$R_{i,t}'=\mu_0+\mu_1 Initial_{i,t}+\mu_2 O_{i,t}+\mu_3 Vol_{i,t}+\mu_4 Size_{i,t}+\mu_5 StdDev_{i,t}+\mu_6 Price_{i,t}+\mu_7 LA_{i,t}+\varepsilon_{i,t}$$

The subscript *i* means 96 initial loan announcement of zero-leverage sample firms. The dependent variables, *R* and *R'* is the closing price-based return and midpoint-based return, for stock *i* at time *t*, respectively. Independent variables include $Initial_{i,t}$, defined as the dummy variables which is equal to one if the trading occurs after the initial loan announcements otherwise it is equals to zero. $O_{i,t}$ refers to the order flow ratio for stock *i* at time *t*. $Vol_{i,t}$ is the natural logarithm of the average daily volume of trading in stock *i* at time *t*. $Size_{i,t}$ is the natural logarithm of the market capitalization of zero-leverage firm *i* at time *t*, $StdDev_{i,t}$ is the natural logarithm of standard deviation of the stock prices as to capture the volatility in the true price for stock *i* at time *t*. $Price_{i,t}$ is the natural logarithm daily average share price of stock *i* at time *t,* and $L/A_{i,t}$ is the natural logarithm of the loan amounts to total assets ratio. Two tailed tests of significance are reported as follows, ***less than 1%, **less than 5% and * less than 10%.

Panel A: All trades

	Closing price return		Mid-point return	
	Coef.	T-stat	Coef.	T-stat
Constant	-3.066	-11.02***	-2.533	-9.58***
O	-0.057	-4.69***	-0.042	-2.14*
Initial	0.023	2.05*	0.018	1.44*
Vol	0.054	4.18***	0.004	1.21
Size	0.000	1.22	0.007	1.31
StdDev	-0.012	-3.03**	-0.001	-1.09
Price	0.035	2.37**	0.001	1.10
L/A	0.000	0.98	0.000	1.04

Panel B: Small trades

	Closing price return		Mid-point return	
	Coef.	T-stat	Coef.	T-stat
Constant	-2.713	-7.64***	-2.085	-6.88***
O	-0.011	-1.69*	-0.010	-1.58*
Initial	0.036	2.51**	0.032	2.46**
Vol	0.047	3.06**	0.009	1.42
Size	0.002	1.04	0.011	1.61*
StdDev	-0.016	-1.78*	-0.000	-0.76
Price	0.024	2.74**	0.007	1.37
L/A	0.000	0.73	0.000	0.52

Panel C: Large trades

	Closing price return		Mid-point return	
	Coef.	T-stat	Coef.	T-stat
Constant	-1.069	-8.69***	-2.140	-5.28***
O	-0.106	-5.43***	-0.094	-3.67***
Initial	0.020	1.86*	0.021	2.13*
Vol	0.061	3.15**	0.007	1.25
Size	0.000	1.04	0.002	0.87
StdDev	-0.003	-1.20	-0.000	-0.46
Price	0.033	2.22**	0.001	0.73
L/A	0.000	0.42	0.000	0.61

Table 5. Robustness Test: The Price Effect Associated with Initial Bank Loan of Zero-leverage Firm

Table 5 provides the daily average returns (AR) from the pre-announcement to the post-announcement period calculated by both ask quote (Panel A) and bid quote (Panel B) which provides the bid-ask bias purged return. The sample consists of 96 FTSE 350 listed firms that undertook an initial bank loan during the time period of 2000-2015. T-statistics are presented to show if sample loans' AR are significantly different from zero. Event day (day zero) presents the day of the bank loan announcement. Two tailed tests of significance are reported as follows, ***less than 1%, **less than 5% and * less than 10%.

Event Day	**Panel A: ask-to-ask returns (N=96)**		**Panel B: bid-to-bid returns (N=96)**	
	AR (%)	**T-Stat**	**AR (%)**	**T-Stat**
(-90,0)	0.348	3.40***	0.171	1.86*
(-80,0)	0.259	2.66**	0.397	3.45***
(-70,0)	0.230	2.07*	-0.268	-2.43**
(-60,0)	0.615	5.11***	0.326	3.21***
(-50,0)	0.427	4.18***	0.267	2.68**
(-40,0)	0.218	2.69**	0.032	1.22
(-30,0)	0.305	3.24***	0.167	1.78*
(-20,0)	0.233	2.17*	0.278	2.82**
(-10,0)	0.029	1.12	0.188	1.74*
-5	0.297	2.90**	0.196	1.98*
-4	0.243	2.42**	0.102	1.19
-3	0.155	1.23	0.072	0.93
-2	0.481	4.21***	0.363	3.83***
-1	0.609	5.09***	0.445	4.17***
0	2.883	13.25***	2.315	11.19***
1	2.129	11.37***	1.233	8.01***
2	1.049	9.14***	0.790	6.80***
3	0.868	7.78***	0.712	6.61***
4	0.633	5.38***	0.610	5.34***
5	0.615	5.12***	0.558	4.93***
(-1, +1)	5.621	7.23***	3.993	13.27***
(-2, +2)	7.151	16.00***	5.546	15.77***
(-5,+5)	9.965	19.18***	7.796	18.81***
(0,10)	0.280	2.90**	0.117	1.42*
(0,20)	0.346	3.78***	0.225	2.69**
(0,30)	0.288	2.75**	0.284	2.95**
(0.40)	0.390	4.06***	0.297	2.97**
(0,50)	0.061	1.82*	0.351	3.74***
(0,60)	0.367	3.86***	0.448	4.90***
(0,70)	0.678	5.83***	0.102	1.33
(0,80)	0.188	1.78*	0.161	1.79*
(0,90)	0.196	2.01*	0.238	2.43**