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The option market reaction to bank loan announcements

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Abstract

In this study, we examine the options market reaction to bank loan announcements for the population of US firms with traded options and loan announcements during 1996-2010. We get evidence on a significant options market reaction to bank loan announcements in terms of levels and changes in short-term implied volatility and its term structure, and observe significant decreases in short-term implied volatility, and significant increases in the slope of its term structure as a result of loan announcements. Our findings appear to be more pronounced for firms with more information asymmetry, lower credit ratings and loans with longer maturities and higher spreads. Evidence is consistent with loan announcements providing reassurance for investors in the short-term, however, over longer time horizons, the increase in the TSIV slope indicates that investors become increasingly unsure over the potential risks of loan repayment or uses of the proceeds.

Keywords: bank loan announcements, option pricing, implied volatility, term structure of implied volatility

JEL Classification codes: G13, G14, G20, G21

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1. Introduction

Past research has provided evidence that bank loans are somewhat 'special' in comparison to bonds or other types of financing, in the sense that they have been associated with positive, rather than negative, stock market reaction to relevant announcements (see James, 1987; Mikkelson and Partch, 1986; Lummer and McConnell, 1989; Slovin et al., 1992; Best and Zhang, 1993; Billett et al., 1995; Preece and Mullineaux, 1994), in contrast to other types of financing e.g. bonds (James, 1987; Eckbo et al., 2007). This positive market reaction to bank loan announcements has been attributed to banks serving a monitoring, as well as an 'information-asymmetry-mitigating' role (Fields et al., 2006), providing certification that the firm receiving the loan was able to convince the bank to grant this funding (Cook et al., 2003). However, another stream of research has criticized the validity of the results of such event studies, mainly in relation to the limited number of loans being actually announced in press (Gonzalez, 2011), which has been considered to be non-representative of the overall population of firms obtaining bank loans, implying that if all loans were to be announced, no significant market performance should be observed (Maskara and Mullineaux, 2011a). In a similar vein, other research has observed that positive market appraisal of loan announcements has diminished in recent years (Fields et al., 2006), with this being more pronounced for firms with higher levels of information asymmetry between insiders and outsiders, that is, for example, for smaller, but not larger firms (Fields et al., 2006, and Slovin et al., 1992, in accordance with Diamond's 1991 hypothesis).

In this paper, we examine the option market reaction to bank loan announcements made by North American listed firms during 1996-2010. Past research has not reached a unanimous conclusion about whether bank loan announcement are indeed 'special' by producing a significantly positive reaction by market participants. This is because on one hand, a significant number of studies have provided evidence consistent with such a conclusion, but on the other hand, Maskara and Mullineaux (2011a) and Fields et al. (2006, for more recent loans) have provided evidence that bank loan announcements are not actually different with respect to producing a positive stock market reaction, while the same research has distinguished between firms exhibiting larger as opposed to lower levels of information asymmetry, suggesting that the latter group of firms does not experience such significant stock market returns (Maskara and Mullineaux, 2011a). In that sense, we examine whether options markets significantly react to bank loan announcements, given that firms traded in option markets should be expected to be on average larger, and are therefore assumed to face less information asymmetry. Regarding, however, market reaction and price discovery, a number of studies have reached the conclusion that *option markets* actually lead *stock markets* (Ansi and Ouda, 2009), with the most sophisticated and informed traders trading in the options markets, rather than in the stock markets (Xing et al., 2010; Diavatopoulos et al., 2012; Jin et al., 2012; Goodman et al., 2012).

In that respect, this study examines the reaction to bank loan announcements for the market which has been considered to be more informationally sophisticated. We focus on firms which should be expected to face the least information asymmetry, from the moment they have equity securities traded in the stock market as well as option contracts traded in options markets, so they should be expected to represent the subsample of the population of stock market traded firms most 'in the limelight.' In the process of this examination, we employ for the first time the *entire population* of firms in Compustat-CRSP-Optionmetrics, manually track whether their bank loans have been announced, and provide real, rather than inferred evidence, on the option market reaction to loans announced from this entire population.

Volatility implied from equity option contracts (hereafter IV) represents today's market assessment of future volatility, and is widely considered a forward-looking measure of investor expectations about the risk and future economic performance of firms. At the same time, observed option prices can be used by market participants to infer volatility expectations over different time horizons, providing a reflection of the market's assessment of the uncertainty over different time horizons (Campa and Chang, 1995). This 'term structure' of implied volatilities (hereafter, TSIV) from equity options should be reflective of long or medium-term (relative to short-term) uncertainty expectations of market participants with respect to the underlying stock return. TSIV is expected to be reflective of the market's assessment of long-term vs. short-term uncertainty over the future economic performance of underlying firms, and thus we explicitly examine the path followed by the TSIV around bank loan announcements. A steeper (flatter) TSIV curve implies a stronger (weaker) deviation of short-term in comparison to long term implied volatility. In the same direction, a positive (negative) change in the slope of the TSIV around earnings announcements implies that investors are becoming increasingly unsure about the relative level of long-term (short-term) equity volatility.

We therefore examine the option market reaction to bank loan announcements by assessing short-term IV (using option contracts with 30 days to maturity) levels and changes, as well as the level and change in the TSIV around announcements. We expect that in case bank loan announcements are indeed value-relevant, this should translate in a statistically and economically significant relation between such events and the levels and changes of short-term IV and TSIV around the event. At this point, a key difference between stock and option markets is that the former produced directional reactions (i.e. positive or negative stock returns) while the latter responds to news through changes in implied volatility (with resulting changes in the prices of option contracts), indicating that traders become increasingly or decreasingly sure on the future prospects of firms over different time horizons. At the same time, bank loan announcements are not, by their nature, fully-expected events on a periodic basis by investors, as is the case with earnings announcements, with a corresponding question about the extent to which market participants incorporate news about them in their trading. In case option investors consider that securing bank loan financing provides reassurance and certification for borrowing firms, and this event is fully anticipated, we should observe decreases in IV, at least in the short-run, around, and especially, following such announcements. However, if options market traders consider that imminent loan announcements may result in material changes in their assessment of future cash flow generation and downside risk by borrowing firms, but they are not fully anticipated by option market participants, we should expect increases in short-term IV before loan announcements, and possible decreases after the event, in case investors have received some reassurance. This would resemble the pattern of implied volatility behavior observed around corporate earnings announcements (referring to an increase or 'run-up' in IV before the event, and decrease or 'run-down' after the event has taken place; Whaley and Cheung 1982; Donders and Vorst 1996; Dubinsky and Johannes 2005; Truong et al., 2012).

Regarding the effect of the above expectations on the slope and changes in the TSIV, the short-term end of the curve should be mechanically affected given any possible changes in short-term IV around loan announcements. However, as new bank loans would affect the long-term financial position of the firm, with respect to the materialization of possible investment opportunities funded with the loans, or the ability of the borrowing firm to service its debt efficiently in the future, we expect that loan announcements convey material information which should be expected to influence the long-term risk and uncertainty profile of the borrowing firm. In this respect, any decrease in the slope of the TSIV after loan announcements would imply that investors become more reassured and consider that long vs. short-term uncertainty has decreased given the certification benefits obtained by the loan, whereas an eventual increase in the TSIV slope, would imply that option market investors become more uncertain over the longer-term prospects of the firm and related downside potential, as a result of the granted bank loan. We consider the second possibility for option market reaction to be more plausible than the first one, given that imminent bank loans are indeed expected to change the risk profile of firms and corresponding future ability to repay debt in the future to a greater extent compared to certification benefits granted to the borrower through the bank loan process.

By using the entire population or universe of loans from Dealscan that are issued to firms with accounting data on Compustat and options data on Optionmetrics during 1996-2010, we first find that around 42% of loan facilities (corresponding to a lower number of deals) are overall announced either by the firm itself (22.4%) or by parties other than the firm (19.5%), for example, the bank which grants the loan or the press in general, by searching for such announcements in the Lexis/Nexis database. To the best of our knowledge, this constitutes for the first time evidence on actual numbers of loans being announced, using the entire population rather than sampling techniques (Maskara and Mullineaux, 2011a, and Gonzalez, 2011).

Using a standard 'event study' methodology, we examine the statistical significance of IV and TSIV levels and changes for at-the-money equity options around bank loan announcements (1 and 10-day windows), and our evidence first points towards a significantly positive level of short-term IV and a significantly negative slope in TSIV (a mechanical result of high short-term IV) on the day of the loan announcement, consistent with short-term IV being exceptionally high on the day of loan announcements, as is the case with earnings announcements (Truong et al., 2012). Our evidence is further consistent with a significant *decrease* in short-term IV around (imminently before as well as after) loan announcements, and a significant *increase* in the slope of the TSIV around the event, with this evidence to be confirmed in the case of the ten-day window around the event. To the extent that this time window allows us to examine the overall effect of the announcement on IV by insulating this examination from any short-term market microstructure issues centered around the event day, this evidence is considered to be consistent with loan announcements providing a certain amount of reassurance for investors in the short-term, however, over longer time horizons, the increase in the TSIV slope indicates that investors become increasingly unsure over borrowing firm prospects in the long-run. At the same time, we get evidence on a significant increase in short-term IV from ten days before up to the day of the event, consistent with option market traders expecting that the imminent announcement should contain relevant information, and our evidence further indicates that all relevant information has been incorporated within options pricing at least one day before the event.

Maskara and Mullineaux (2011a) conjecture that loan announcements by parties other than the firm may be more likely related to information asymmetries, compared to loans announced by firms themselves. In this context, the above analysis was performed both for loans announced by firms themselves as well as for loans announced by any party, with results to have remained qualitatively similar. We then repeat our analysis for loans of different credit ratings (speculative, investment grade, or unrated), maturity (shorter or longer than two years), spread size (lower/higher than 150 basis points (bp)), and level of firm information asymmetry (using the methodology proposed by Maskara and Mullineaux, 2011a, for information asymmetry assessment). Our findings on IV and TSIV dynamics appear to be more pronounced for firms with more information asymmetry, lower credit ratings–or no credit rating–as well as loans with longer maturities and higher spreads. These results are consistent with a stronger reaction of option markets to the loans which are more likely accompanied by a greater degree of uncertainty, greater difficulty in making accurate predictions about future firm performance and possibly resulting in increased downside risk.

Furthermore, we examine which firm-specific and loan-specific factors most significantly relate to the reaction of option markets to loan announcements. Our analysis, that explicitly accounts for the inherent self-selection of firms announcing their new loan issues (self-selection bias, Heckman, 1979), identifies a considerable number of firm and loan-specific factors significantly relating to the level and changes of short-term IV and TSIV. More specifically, we find that option markets react more strongly to announcements by smaller firms, and by firms with lower profitability, higher historical cash flow volatility and leverage ratios, while this reaction further depends on loan size and number of lenders. This evidence is consistent with option markets reacting more sensitively to loans possibly creating stronger material changes to the firm, in accordance with Maskara and Mullineaux (2011a), referring to loans requiring a larger lender base (to the extent that a larger number of lenders provides more efficient diversification, Preece and Mullineaux, 1994), and loans of firms with fundamental attributes which could be intuitively considered to be more risky, such as small size or high cash flow volatility. We consider this evidence to constitute a significant degree of option market efficiency, especially since stock markets have not been observed to exhibit relevant sensitivity to such an extent (Byers et al., 2008).

Finally, given our findings of statistically significant decreases (increases) of short-term equity option implied volatility (implied volatility term structure) following firm loan announcements, we move to explore whether these observed dynamics are economically exploitable, by implementing a (self-financed) option trading strategy that yields statistically significant profits in-sample. The strategy is implemented by 'going long' the equity volatility term structure of firms announcing new loan facilities (via at-the-money straddles with the longest available time to maturity), it is self-financed (in that the long positions are sustained by 'going short' the necessary number of at-the-money straddles with the shortest available expiry) and it yields—in the absence of transaction costs—a statistically significant average return of 1.66% on the (self-financed) average position size of $500. Although the profits of our trading strategy are diminished by transactions costs and are well-within the bid-ask spreads that an investor in the option market would face, the results of our trading exercise undoubtedly establish the economic (in addition to the statistical) significance of the option market reaction, as manifested by implied volatility, to loan announcements.

Our study contributes to the literature in a number of ways. First and foremost, this is the first study that examines the option market reaction to loan announcements made by firms. Secondly and equally importantly, our study bases its entire analysis on *all loan announcements* (manually-collected from

Lexis/Nexis) made by *all firms* with data on Compustat and Optionmetrics and bank loan data on Dealscan.

Previous studies (e.g. Maskara and Mullineaux, 2011a; Gonzalez, 2011) have examined the stock market reaction to firm loan announcements, by first using random sampling techniques in order to construct a representative sample of loans from the Dealscan database, and then by estimating abnormal stock returns for the subsample of loan deals that were actually announced. The reaction of the options market, although it has been shown to lead the stock market in several respects (e.g. price discovery, see the review by Ansi and Ouda, 2009), has been neglected by previous research, and our study fills this gap by establishing that there are statistically significant decreases of short-term implied volatility, and significant increases in the slope of the implied volatility term structure around the loan announcement day. These findings appear more pronounced for loans by firms which could be considered to be facing more information asymmetries or possess fundamental characteristics traditionally linked to greater risk e.g. smaller size, or cash flow volatility, and are consistent with the view that loan announcements provide reassurance for investors in the short-term (due to the monitoring role that loan issuing banks can play); however, over longer time horizons, the increase in the slope of implied volatility term structure would indicate that investors become increasingly unsure over borrowing firm prospects in the long-run.

Our findings on the options market reaction to firm loan announcements are unique and assertive: they are based on the entire population of such announcements by listed firms with options traded on their common stock during 1996-2010, accomplishing a level of assertion that cannot be obtained to a comparable extent by the frequently-used population sampling techniques of related studies examining the reaction to loan announcements. Finally, we indirectly contribute to the debate on the nature of firm loan announcements by establishing that, for the options market, such announcements are indeed economically significant and exploitable, through a profitable trading strategy that is based on our main findings.

The rest of paper is organised as follows: Section 2 presents the sample selection process and the methodology for the estimation of the options market reaction. Section 3 reports our empirical findings, while Section 4 summarizes the results of a self-financed option trading strategy that is motivated by our empirical findings. Section 5 concludes the paper.

2. Sample selection and methodology

2.1 Sample selection

We begin our analysis by matching firms from Compustat with common stocks traded on the NYSE, AMEX, and NASDAQ to firms that have equity options data on the Ivy DB OptionMetrics database between 1996 and 2010 (excluding firms in the financial and government sectors, i.e. with SICs in the 6000s and 9000s), and this matching process yields 4,798 individual firms.[4] We then retrieve data on loan deals and facilities from LPC's Dealscan database for North American firms (regardless of date each facility was active) and this process yields 133,950 different loan facilities.[5] Dealscan reports data on a variety of bank loan contract terms, referring to different deals, which may include one or several loan facilities. All data on loan contract terms are reported at the facility level, and following past research (Qian and Strahan, 2007; Kim et al., 2011; Ferreira and Matos, 2012), all our empirical analysis is performed at the facility level.[6]

As the only common identifier between Compustat and Dealscan is firm ticker, in accordance with past research (Qian and Strahan, 2007; Bae and Goyal, 2009; Ferreira and Matos, 2012, Hasan et al., 2012), we merge the 4,798 firms obtained from the Compustat/Optionmetrics matching with Dealscan; this merging is performed first by firm name and then by firm ticker, followed by a manual control of the obtained results.[7] This way, in essence, the matching between the databases is performed mainly by name, with a significant part of this process to represent hand matching. At this point, Maskara and Mullineaux (2011a) mention that they exclude observations from Dealscan without a ticker symbol (Maskara and Mullineaux, 2011a, p. 686). However, this would result in excluding a great number of firm loans simply because Dealscan does not report ticker data on them, and which are also in practice recycled (Hasan et al., 2012–making manual confirmation of the matching performed according to them absolutely necessary), which justifies performing matching by

[4] January 1996 is the first month for which options data are available on Ivy DB OptionMetrics.

[5] Data download from Dealscan as of February 2012.

[6] We follow the aforementioned studies and consider each facility to be a separate observation for the sample, given loan characteristics as well as loan spreads may very well vary across facilities (Kim et al., 2011, pp. 1,166 and footnote 15). At this point, Billet et al. (2011) mention that each of their events represents a deal, rather than a facility (footnote 3) and Cook et al. (2003) make use of only the facility listed first in each of the deals, but find no material difference in their results if they not control for multiple facilities with the same borrower–lender combinations (footnote 21). However, different facilities corresponding to the same deal may possess different loan characteristics (e.g. different maturities for different tranches of the deal), so we follow from previous research focusing the analysis on the facility level, while we address this issue by making use of standard errors clustered at the firm level in all regression analysis that follows (Graham et al., 2008; Petersen 2009; Gow et al. 2010; Kim et al., 2011). On several instances, the expressions 'loan facility' and 'loan' are used in text without distinction, by making reference to loan facilities each time.

[7] In cases where a number of different borrowers were mentioned for a particular facility in Dealscan, matching with Compustat firms was performed for the borrowing firm which was mentioned first.

name in addition to ticker between Dealscan and accounting data databases, as has been done by previous studies (Qian and Strahan, 2007; Bae and Goyal, 2009).

This matching process results in a total of 2,221 different firms (after 1996) corresponding in a total of 12,928 different loan facilities, for which the rest of the data used in the study is data-dependent. Finally, for these firms, stock returns, when necessary in the analysis, have been retrieved from CRSP and data on analysts' forecasts from IBES. Detailed definitions for all variables employed in the study are provided in Appendix A.

The next step in our sample collection was to manually search in the Lexis/Nexis database (also employed by past research, e.g. Fields et al., 2006; Byers et al, 2008; Ongena and Roskovan, 2009) in order to investigate which of these 12,928 facilities were announced. In accordance with Fields et al. (2006, pp. 1 and 198) we search Lexis/Nexis for the terms 'bank loan', or 'line of credit', or 'credit agreement', or 'credit facility'.[8] In accordance with the time window employed by Maskara and Mullineaux (2011a), we search for an announcement in a period ranging from six months before until two months after the loan facility active date, with the vast the majority of our identified loan announcements to take place in a window of +/- 15 days around the facility active date (confirming Maskara and Mullineaux, 2011a, at this point).

In accordance with past research (e.g. Maskara and Mullineaux, 2011a) that hypothesizes in favour of different information asymmetry levels depending on the actual source of loan announcements, we distinguish between identified loan announcements made by either the borrowing firm, the lending bank or another identified source in the press (which is neither the firm nor the bank). Out of our 12,928 facilities, 42% (5,422 out of 12,928 loan tranches or facilities, corresponding to a lower number of deals) are announced by the firm itself (22.4%) or by parties other than the firm (19.5%), for example, the bank which grants the loan or the press in general.[9] The observed percentages of loans being announced generally provide support for the numbers reported in Gonzalez (2011) –22%– and Maskara and Mullineaux (2011a) –a little more than 25%–using randomly selected samples.

It should be mentioned at this point that in accordance with previous research (Billett et al., 2006; Maskara and Mullineaux, 2011a; Maskara and Mullineaux 2011b; Billett et al., 2011; Gande and Saunders, 2012), we make use of LCP's Dealscan Database, which is dominated by syndicated loans.

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[8] More specifically, a so-called 'power search' according to company name was performed in Lexis/Nexis, by indicating that the desired level of relevance is 'strong'.

[9] In case we find an announcement mentioning that *'a borrower is either seeking the loan or expecting to receive the loan or that a lead bank is inviting syndicate members to participate in a loan'* as stated by Maskara and Mullineaux (2011a, p. 686), we then consider that an announcement is indeed made, even if the loan is not considered finalised or a 'done deal'. Nevertheless, from the moment a certain amount of publicity pre-exists about a loan that is subsequently concluded (and thus appears in Dealscan), we do classify it as announced.

More specifically, we observe that 12,104–or 93.6%–out of the 12,928 (announced and unannounced) loan facilities included in our sample state '*Syndication*' as their loan Distribution Method, while more than one lenders are reported for 11,092 tranches. Syndicated loans have been considered to be providing a form of debt financing falling between bank financing and bond financing (Maskara and Mullineaux, 2011b), combining elements of both commercial banking and investment banking at the same time (Dennis and Mullineaux, 2000). Such loans are provided to a single borrower by multiple financial institutions, which form a 'syndicate' for that purpose, and therefore allow credit risk sharing among syndicate members, without the disclosure and marketing issues that bond issuers face. Although syndicated loans represent a hybrid form of lending, having commonalities with bank loans and public debt, they are considered to be closer to the former because of the role of the lead arranger, who is expected to formulate the loan terms and conditions and monitor the borrower and who usually holds the largest share of the loan (Dennis and Mullineaux, 2000; Sufi, 2007). In this respect, Ivashina (2005) finds that syndicated loans are overall cheaper than loans with a single lender loans, Angbazo et al. (1998) find that syndicated loans have lower spreads, while Maskara (2010) observes that syndicated loans with multiple tranches have lower rates than non-tranched loans which have otherwise similar characteristics.[10] Nevertheless, we consider that despite the fact that our sample is dominated by syndicated loans, the examination of this sample may provide representative results on the reaction of the option market to bank loan announcements, in the context of past research making use of the universe of Dealscan data in order to examine the market reaction to such loans (Maskara and Mullineaux, 2011a, among others).[11]

2.2 Methodology for the estimation of short-term implied volatility and implied volatility term structure

We use the volatility implied from equity options as a proxy for market participant's forward-looking view of uncertainty regarding the underlying stock. Estimates of implied volatility are readily available on a daily basis from the OptionMetrics Standardized Options dataset, for both calls and puts that are closest-to-the-money, with maturities ranging from 30 days to 730 days.

As in previous research, we focus on the closest-to-maturity, at-the-money implied volatility (that is the quickest to respond to releases of new information, see for example Truong et al., 2012; Donders

[10] For a detailed description of loan syndication, see also Maskara and Mullineaux (2011b).

[11] Maskara and Mullineaux (2011b), using data from Dealscan, mention that non-syndicated loans are significantly smaller than those that are syndicated, with Dealscan reporting roughly equal number of bank loans and syndicated loans, at least during their 1985–1999 sample period. (footnote 3). We consider that the greater representation of syndicated loans in our sample may also stem from the fact that the 12,928 tranches representing the sample of firms with data on Compustat and Optionmetrics matched with loan data from Dealscan may very well represent larger than average firms from Dealscan.

et al., 2000 and also Goodman et al., 2012; Goyal and Seratto, 2009), to gauge the equity options market reaction to loan announcements. In order to demonstrate the estimation of our short-term implied volatility (IV) and implied volatility term structure (TSIV) measures, let $\sigma^{c}_{i,j,\tau}$ (respectively $\sigma^{p}_{i,j,\tau}$) stands for the firm i equity volatility, as implied from the closest-to-the-money call option (respectively put option) with maturity T_j (in years) on (relative) day τ. Relative day τ should be understood as follows: As we are only interested in the implied volatility (and its term structure) around loan announcement dates, our day indexing τ takes values $[-10, -9, \ldots, +10]$ relative to the firm i loan announcement day (day $\tau = 0$). Moreover, let $\sigma^{a}_{i,j,\tau} = 0.5\left(\sigma^{c}_{i,j,\tau} + \sigma^{p}_{i,j,\tau}\right)$ stand for the simple (call-put) average implied volatility on day τ, and

$$\sigma^{int}_{i,j,\tau} = \frac{\sigma^{c}_{i,j,\tau} \times \left|\Delta^{c}_{j,\tau} - 0.50\right| + \sigma^{p}_{i,j,\tau} \times \left|\Delta^{p}_{j,\tau} - 0.50\right|}{\left|\Delta^{c}_{j,\tau} - \left|\Delta^{p}_{j,\tau}\right|\right|} \quad (1)$$

for the delta-interpolated (call-put) average implied volatility on day τ, with $\Delta^{c}_{j,\tau}$, $\Delta^{p}_{j,\tau}$ the call and put deltas respectively (see Truong et al., 2012 and Mixon, 2009 inter alia for the use of the average and delta-interpolated implied volatility in empirical studies). Finally, for each sample firm i, on day τ relative to its loan announcement day, the following proxies for the implied volatility term structure (TSIV) are also estimated through ordinary least squares:

$$\sigma^{q}_{i,j,\tau} = \alpha^{q}_{i,\tau} + \beta^{q}_{i,\tau} \times T_j + e^{q}_{i,\tau}, \qquad q = \{c, p, a, int\} \quad (2)$$

The (call, put, average and delta-interpolated) implied volatilities that are available on day τ are regressed on their contract expiries T_j (expressed in years), and the simple OLS slopes $\hat{\beta}^{q}_{i,\tau}$ are used as proxies of the implied volatility term structure for firm i on day τ.

Throughout the paper, we report empirical results using the delta-interpolated $\sigma^{int}_{i,\tau} \equiv \sigma_{i,\tau}$ and $\hat{\beta}^{int}_{i,\tau} \equiv \beta_{i,\tau}$ as our base-case implied volatility and term structure proxies, and employ $\sigma^{c}_{i,\tau}, \sigma^{p}_{i,\tau}, \sigma^{a}_{i,\tau}$ and $\beta^{c}_{i,\tau}, \beta^{p}_{i,\tau}, \beta^{a}_{i,\tau}$ to test the robustness of our findings. We will denote with $\Delta\sigma_{[\tau_1,\tau_2]} = \sigma_{i,\tau_1} - \sigma_{i,\tau_2}$ and $\Delta\beta_{[\tau_1,\tau_2]} = \beta_{i,\tau_1} - \beta_{i,\tau_2}$ the changes in IV and the TSIV over time windows surrounding the loan announcement day.[12]

[12] We further use the average of call and put implied volatility (Truong et al., 2012) among our robustness checks. Since both the call and the put implied volatilities from Ivy are close-to-the-money, the average and delta-interpolated implied volatilities are almost indistinguishable (average correlation coefficient in excess of 0.90). Results are unaffected by the use of average, call-only or put-only implied volatility.

3. Empirical findings

3.1 Sample descriptive statistics

Table 1 reports summary statistics for a number of fundamental loan characteristics for the population of loan facilities from the Dealscan database with accounting data on Compustat and options data in Optionmetrics during 1996-2010. The Table reports, in Panel A, descriptive statistics using Dealscan data on the number of lenders (*NoLenders*), facility maturity (*Maturity*, in months), facility Spread (*Spread*), facility size (*TrancheSize*, in U.S. $ millions), and facility size scaled by Total Assets (*Loan-to-Asset ratio*, using Compustat item #6 for the denominator).[13] Panel B of the Table reports information on the fraction of facilities which are secured (*Secured*), and also facility type (*Type*), purpose (*Purpose*), and senior debt credit rating for issuing firms (*Credit Rating* – for unrated firms and in the case of firms with an existing rating, from highest (1) to lowest (6)). All data are reported at the facility level, following Qian and Strahan (2007), Kim et al. (2011), and Ferreira and Matos (2012), for all sample facilities (announced by the borrowing firm, or by any party separately, as described in Section 3.1).

Insert Table 1 about here.

We observe from Panel A of Table 1 that loan facilities which have been announced, either by the firm itself or in general by any party, are comparable to our overall sample of all (announced and unannounced) facilities (from the matched Compustat/Optionmetrics/Dealscan databases) in terms of syndicate size, with an average number of ten lenders, and roughly the same could be said for loan size in terms of amount, when taking into account mean and median values. However, facility size as a percentage of total assets appears to be on average larger for facilities announced by the firm (0.153) or announced in general (0.145) compared to all loan facilities (0.122), with the same trend to be observed for median values as well. This is consistent with the hypothesis made by Maskara and Mullineaux (2011a) that loans representing a large component of the capital structure are more likely to be announced. At the same time, we observe for firm-announced facilities, and for all announced facilities to a weaker extent, that the average facility spread and maturity (in months) are on average larger than the ones observed for the overall population (206.6 b.p. and 195.4 b.p. vs. 162.9 b.p. for announced loans–by the firm and in general–vs. the overall population, respectively, and 51.1 and 50.7 months vs 45.8 months for respective loan maturities, with median values qualitatively similar). In this way, announced loans appear to be riskier in terms of spread magnitude than the population of

[13] In accordance with past research, we employ Dealscan's *'All-in Spread Drawn'* item as our facility spread proxy, which is equivalent to the amount paid by the borrower in basis points (b.p.) over LIBOR or LIBOR equivalent for each dollar drawn (Graham et al., 2008). Please also refer to Appendix A for detailed variable definitions.

announced and unannounced loans, but at the same time granting institutions are observed to feel safe enough to grant them by providing longer time periods for repayment.

Table 1 Panel B further reports that a greater fraction of announced loans are not secured, in comparison to the entire population: about 58% and 53% for loans announced by the firm or in general, vs. 38% for the entire population. A casual comparison of respective loan types does not reveal big differences, with the majority of loans to be credit lines – around 65%. The same holds for loan purpose, with the small exception of a larger percentage of loans to be granted for working capital purposes for announced loans by firms (about 25%, and 21% for loans announced by any party, vs. 16.5% for all loans). Finally, Panel B of Table 1 reveals that greater percentages of facilities for announced loans have senior debt credit ratings of speculative grade (5 and 6) rather than investment grade (1 to 4): around 45% vs. 32%, with relevant percentages for unrated loans to be, however, quite similar (between 34-37%) for all loans, regardless of whether they have been announced or not. Overall, we deduce from descriptive statistics observed from Table 1 that announced loans are on average riskier in terms of credit rating and also spread, with a corresponding larger percentage of them to be secured, while they also appear to represent a larger proportion of borrowing firms' assets.

Table 2 further reports summary statistics for a number of firm-specific variables regarding the population of loan facilities (as defined in Section 3.1 from the Dealscan database) granted to firms with accounting data on Compustat and options data in Optionmetrics between 1996 and 2010. The Table reports statistics using Compustat data on firm size (natural logarithm of Total Assets-$Ln(TA)$), asset tangibility ($GPPE/TA$), leverage (Lev), profitability ($NIBE/TA$), the book-to-market ratio ($BtoM$), and cash flow volatility ($Vol(CFO/TA) -$ calculated using data from the last five years). The Table also reports descriptive statistics on (the levels and changes of) our IV proxy, $\sigma_{i,\tau}$, and our TSIV proxy $\beta_{i,\tau}$ around the loan announcement day. Finally, the Table also reports statistics on an information asymmetry index (*IA*) calculated according to Maskara and Mullineaux (2011a) and also Leary and Roberts (2010), Gomes and Phillips (2010) and Chung and Zhang (2009). This index makes use of information on *Analyst dispersion, Analyst forecast error, Bid-Ask spreads,* and *Stock return residual volatility,* and relevant data (retrieved from the IBES database, and CRSP for stock returns) are reported in a continuous form and also in rank form (in this last case on a variable basis as well as using an aggregate measure, *IA*). The calculation of this composite information asymmetry index (*IA*) index is based on four different information asymmetry proxies, employed by Maskara and Mullineaux (2011a) and Gomes and Phillips (2010), and it is calculated as the average quintile ranking of the borrowing firm based on these four information asymmetry measures.[14] Again, all descriptive statistics are reported at the facility level, and detailed variable definitions are provided in Appendix A.

Insert Table 2 about here.

We observe from Table 2, Panels A to C, that firms with announced loans are on average comparable to the entire loan facility population in terms of size, and also asset tangibility (around 60%), leverage (between 33-36%) and cash flow volatility. Firms with announced loans appear to be slightly less profitable on average compared to the population (mean *NIBE/TA* of 0.008 and 0.013 for loans announced by the firm or by any party, compared to 0.022 for the population), and have book-to-market ratios which are slightly higher (about 0.5 compared to the population average of about 0.48). More importantly, we observe that the average value for the information asymmetry proxy (*IA),* expressed in the average of the rank values of four individual proxies is 3.100 and 2.997 for loans announced by the firm or in general, compared to the lower value of 2.827 for the entire population of announced and unannounced loans. Median values follow the same trend for *IA*, and the final result for respective values is stemming from ranking, on average, higher, in terms of components of the *IA* measure (both in continuous variable as well as in resulting rank value), that is analyst forecast dispersion and forecast error, bid-ask spread, and stock return residual volatility, in the case of announced loan facilities compared to the population of all facilities. This is indicative of a greater probability for a loan facility to be announced, especially by the firm itself, in case the borrowing firm faces greater information asymmetry issues, confirming at this point a relevant hypothesis by Maskara and Mullineaux (2011a) but this time using population data.

Finally, from the descriptive statistics on $\sigma_{i,\tau}$, $\Delta\sigma_{[\tau_1,\tau_2]}$, $\beta_{i,\tau}$ and $\Delta\beta_{[\tau_1,\tau_2]}$, we observe that average IV levels and TSIV slope are positive on the event day, with relevant median values to be negative, possibly indicating the beginning of the resolution of short-term IV as the loan announcement event has occurred. At the same time changes in short-term IV appear to be overall negative around the event using median values, with positive median changes in the slope of the TSIV around, and especially after the event, providing an initial (and not statistically significant) indication on a

[14] The information asymmetry proxies we employ and the exact calculation of our *IA* composite index follows the work of Maskara and Mullineaux (2011a), Gomes and Phillips (2010), Leary and Roberts (2010), and Chung and Zhang (2009), as well as the work of the researchers they cite (Dierkens, 1991; Krishnaswami et al., 1999; Krishnaswami and Subramaniam, 1999; Bharath et al., 2009). Maskara and Mullineaux (2011a) actually use a total of six information asymmetry proxies in constructing their composite index; however, we focus on the four proxies mentioned in the text (and explained in Appendix A) which represent the common ground in the aforementioned studies.

tendency of short-term IV to decrease and term structure slope to increase around or following loan announcements.

3.2 Event study analysis: IV and TSIV levels and changes around bank loan announcements

We first perform a standard event study analysis in order to assess the reaction of the options market to loan announcements, by examining the statistical significance of short-term IV and TSIV levels and changes around loan announcement events. Table 3 reports means and medians of at-the-money, short-term implied volatility levels $\sigma_{i,\tau}$, and changes $\Delta\sigma_{[\tau_1,\tau_2]}$, as well as levels $\beta_{i,\tau}$ and changes $\Delta\beta_{[\tau_1,\tau_2]}$ of at-the-money implied volatility term structure, on or around day τ relative to the sample firms' loan announcement date (day 0). In Panel A, we report mean and median values for volatility metrics for loans announced by firms themselves, and in Panel B, we repeat our analysis for loan announcements made by any party. The calculation of short-term IV and the term structure of IV is as described in Section 3.2.

Insert Table 3 about here.

We observe from Table 3 Panels A and B that average (and median) short-term IV is significantly positive on the day of bank loan announcement, while the slope of the TSIV curve is significantly negative (using median, but not mean values); both observations are consistent with an increase in short-term IV on the event day, pushing this way the slope of the TSIV downwards. This result is considered to be consistent with increased uncertainty experienced by market participants regarding the content of the announcement and its possible impact on the firm prospects, which is expressed by higher levels of short-term IV. Regarding changes in short-term IV, we observe significant increases in short-term IV between ten days before the announcement up to the event day (only for loans announced by the firm – using mean and median values), and significant decreases or resolution in such volatility around (windows of [-10,+10] and [-1,+1]) or after (windows of [0,+10] and [0,+1]) the announcement (using median values) for all loans (regardless of who announced the loan); the time window [-1,0] with reference to the announcement is observed to exhibit the same behavior as is the case with pre-post or after the event time windows. These results are stronger in the case of medians, compared to means, and in the case of the [-1,0] event window, they are considered to be an indication of incorporation of all relevant loan event information within IV dynamics right before the event has occurred, resulting from significant market efficiency.

In the case of changes in the TSIV slope, we observe (with the exception of the of [-10,0] event window) a significant tendency for the slope to increase around or after the event, especially when using median rather than mean values for TSIV changes. Most interestingly, the significant tendency for an increase in the slope of the TSIV is also in the case of the [-10,+10] window using median values, an indication that the loan announcement event has overall resulted in *increases* in the TSIV slope, regardless of any market microstructure influence the event could have had on the behavior of the TSIV on the days immediately preceding or succeeding the event, consistent with investors becoming more unsure on the long-term economic prospects and downside risk potential of borrowing firms as a result of the loan agreement.

Overall, the option market appears to react more intensely and results are observed to be stronger for loans announced by the firm itself rather than announced in general (despite the larger number of observations for the latter group), consistent with Maskara and Mullineaux's (2011a) expectation for stronger information asymmetries for loans announced by firms themselves. Moreover, we observe very weak results for the [-10,0], an indication that market participants may not be very well informed and anticipating the incidence and informational content of the imminent loan announcement. Taken as a whole, results are considered to be consistent with a material influence of loan announcement events on the behavior of IV on the day or around the announcement event, resulting in increased uncertainty experienced by market participants which is expressed by higher levels of short-term IV on the day of the event, and a significant resolution in short-term volatility once the event has occurred. However, overall the loan announcements by the firms are observed to significantly modify the short vs. long term risk estimation profile for borrowing firms, resulting in significant increases in the TSIV slope around or after the loan announcement.

In order to complement our event study results so far, we repeat the analysis, by splitting the population to sub-samples that are constructed based on several different loan characteristics. In Panel A of Table 4, we separate loan facilities depending on (a) whether they have been announced by the firm itself or by any party other than the firm, (b) according to credit rating (investment grade vs. speculative grade or unrated senior debt), (c) maturity (shorter or longer than two years), and (d) spread size (lower/higher than 150 basis points (bp)). In Panel B, we separate loan facilities according to firm information asymmetry proxies, using the methodology proposed by Maskara and Mullineaux (2011a) for information asymmetry measurement, from lowest (1) to highest (5).

Insert Table 4 about here.

There can be observed from Table 4 Panel A that there do not exist on average significant and consistent differences in the behavior of short-term IV and the TSIV depending on whether a loan has been announced by the firm itself or announced by any party other than the firm. A notable exception to this is the level of short-term IV on the day of the loan announcement event, which is significantly higher for loans announced by the firm itself. Short-term IV on the day of the announcement event also appears to be significantly higher for loans without a senior debt credit rating, or credit ratings at the speculative rather than investment grade, while speculative grade and even more unrated loans are observed to experience significantly larger increases in the slope of their TSIV curve around or after loan announcements. The option market reaction to loan announcements is also overall found to be more pronounced for loans with higher maturity (higher vs. lower than two years) and higher spreads (higher vs. lower than 150 b.p.), especially when it comes to the level of short-term IV on the loan announcement day, although this result is not observed to be the case for all time windows examined.

We further observe from Table 4 Panel B an almost monotonic and statistically significant increase in the level of short-term IV as information asymmetry levels for borrowing firms also increase. At the same time, we observe that changes in short-term IV tend to become significantly more pronounced as information asymmetry increases, and the same applies for changes in the slope of the TSIV, although not for all time windows examined. In this context, our findings from Table 3 appear to be more pronounced for firms with higher vs. lower levels of information asymmetry, and also lower credit ratings or no credit ratings at all, and loans with longer maturities and higher spreads. We consider these results to be consistent with a stronger reaction from the side of option market participants to bank loans with a possibly higher degree of uncertainty and difficulty to make accurate predictions on the future firm economic performance, and resulting possibility for downside or default risk of borrowing firms.[15]

3.3 Determinants of option market reaction around bank loan announcements

Research on the stock market reaction to bank loan announcements has been quite limited with respect to which factors make this reaction stronger vs. weaker. With the exception of Slovin et al. (1992) for firm size, Best and Zhang (1993) for creditor creditworthiness, Billett et al. (1995) and Handlock and James (2002) for credit ratings and spreads, respectively, or Fields et al. (2006) for firms with poorer marker performance up to the announcement, past studies do not consistently identify significant firm-specific factors making stock market reaction stronger vs. weaker in the context of regression analysis. For example, Byers et al. (2008)–using the sample of Fields et al. (2006)–find that the only firm-specific factor (unrelated to corporate governance) which significantly relates to stock returns is the existence of debt in the borrower's capital structure.

Moreover, none of the past studies we are aware of take into consideration the *"self-selection bias [that] affects extant loan announcement research"* as Maskara and Mullineaux (2011a, p. 684) point

[15] Table 4 reports information on a more limited number of time windows compared to Table 3 for brevity. Results in Table 4 are qualitatively similar (actually stronger) when using median rather than mean values. Moreover, tests in Table 4 have been re-calculated (where applicable) for all loans that have been announced by any party (by the firm or any other party), but remain qualitatively similar if repeated for loans announced by the firm only.

out: firms ‘self-select’ to announce the securing of a new loan facility, potentially introducing endogeneity into the findings of any simple regression analysis that attempts to identify factors related to market reaction to the announcement.

Therefore, in this section of our analysis, we examine which firm or loan-specific factors possibly affect the option market reaction to bank loan announcements through the use of a two-step Heckman (1979) selection model for both short-term IV and the TSIV. We employ the Heckman (1979) two-step procedure, in an effort to account for endogeneity, sample selection issues and possible influences in the way firm or loan-specific factors relate to the option-market reaction to bank loan announcements stemming from the very fact that such loans have been announced. The first step in the Heckman (1979) procedure estimates a probit model over the entire sample of announced and unannounced loan facilities, in order to test for possible factors with an influence on the possibility for a bank loan to be announced by the firm or not. The model estimated in the first step is

$$Pr\left[Announced\ by\ firm_{i,t} = 1\right]) = \Phi\left(\boldsymbol{z}_{i,t}\boldsymbol{\gamma} + e_{i,t}\right)$$
$$= \Phi(\gamma_0 + \gamma_1 IA_{i,t} + \gamma_2 TRANCHE_{i,t}/TA_{i,t} + \gamma_3 LOSS_{i,t} + \sum_m \gamma_{6,m} YearIndicator_{m,i,t} + e_{i,t}) \quad (3)$$

The variable $Announced\ by\ Firm_{i,t}$ is a dummy variable that equals 1 if the loan facility i in year t was announced by the firm itself, and zero if the firm did not make such an announcement. Operators $Pr[.]$ and $\Phi(.)$ denote probability and the cumulative distribution function of the standard normal distribution respectively. All independent variables are as defined in Appendix A. The choice of independent variables included in the first stage of the Heckman procedure follows directly from the hypotheses and evidence in Maskara and Mullineaux (2011a); they are expected to capture factors that make a loan more or less probable to be announced by the borrowing firm.[16]

In the second stage of the Heckman (1979) two-step procedure, we estimate the following specification, in an effort to directly assess which firm or loan-specific factors with a possible

[16] In the first-stage equation, we make use of a bottom-line negative earnings dummy variable while Maskara and Mullineaux (2011a) use a relevant variable for negative EBITDA, to account for the effect of bottom-line earnings on the probability that a loan is secured or not. Findings remain qualitatively similar when a size regressor (natural logarithm of market value of equity) is added in the probit model regression, in line with one alternative model specification used by Maskara and Mullineaux (2011a), and the same applies when estimating an ordered probit model, in which the dependent variable takes different values depending on whether the bank loan was announced by the firm itself, by parties other than the firm, or not announced at all (untabulated data). Results from the probit model estimation (and also overall results from Tables 5 and 6) remain qualitatively similar in case the dependent variable takes the value of one if the loan is announced by any party (rather than the firm itself) and zero otherwise (untabulated results). We chose, however, to report results when the dependent variable is equal to one when the loan is announced by the firm, in line with Maskara and Mullineaux (2011a), as such loans are expected to be more strongly related to information asymmetries. Finally, results from Tables 5 and 6 are robust to the inclusion of industry dummy variables (according to 2-digit SIC codes (untabulated results) in addition to year indicator variables for both stages of the Heckman (1979) estimation procedure.

influence on the option market reaction to bank loan announcements are significant, after controlling in the first stage for sample selection bias (option market reaction is only observed for announced loans):

$$\left\{\sigma_{i,\tau}, \beta_{i,\tau}, \Delta\sigma_{[\tau_1,\tau_2]}, \Delta\beta_{[\tau_1,\tau_2]}\right\} = \alpha_0 + \alpha_1 Market\ control_{i,t} + \sum_k \alpha_{2,k} Firm - specific\ controls_{k,i,t}$$

$$+ \sum_l \alpha_{3,l} Loan - specific\ variables_{l,i} + \alpha_4 IMR_{i,t} + \sum_m \alpha_{5,m} YearIndicator_{m,i,t} + \varepsilon_{i,t} \quad (4)$$

We employ all of our IV and TSIV proxies, levels and changes around the announcement day, as dependent variables in separate estimations of the Heckman (1979) second stage. We include the VIX index (in level or change form, depending on the time window of the dependent variable each time) as a market control to account for the effect of overall market uncertainty on firm equity option market reaction to bank loan announcements. Firm-specific control variables include firm size, tangibility, leverage, profitability, growth (using the book-to-market ratio as a relevant proxy) and cash flow variability.[17] Loan specific independent variables include an indicator variable for loan securitization, loan (tranche) size, maturity, number of lenders, loan spread, and credit rating. We further employ controls for loan type and purpose, following past research examining determining factors of bank loan pricing (see for example Graham et al., 2008, and Kim et al., 2011). The selection of the control and independent variables that are included in the right-hand side (all of them defined in Appendix A) is largely based on past research regarding the effect of firm or loan-specific factors on the behavior of stock markets to bank loan announcements (e.g. Byers et al., 2008, Billet et al., 1995, 2006 and Slovin et al., 1992, for firm size; Best and Zhang (1993) for creditor creditworthiness and Hadlock and James (2002) for credit spreads). Finally, the second-stage equation features the so-called inverse Mill's ratio (IMR_i) that is produced by the first stage of the Heckman (1979) procedure and accounts for the potential omitted variable problem caused by the non-random nature of our loan announcements.

Estimation of the two equations of the Heckman (1979) procedure is performed via Full-information Maximum Likelihood and results are summarized in Tables 5 and 6. In both tables, the coefficients' statistical significance is assessed by making use of robust standard errors, clustered at the firm level. In both tables, Panel A reports estimation results for the first step of the Heckman (1979) estimation

[17] Fields et al. (2006) find that bank loan renewal announcement returns are more likely to be positive for firms with poorer stock price performance up to the announcements, while Hadlock and James (2002) relate the level and volatility of prior year returns to the probability of a bank agreement over a public debt issue taking place. In this respect, we have repeated the analysis by including regressors for the level and volatility of market performance (well and above the volatility of operating cash flows) and (untabulated) results remain qualitatively similar.

procedure, while Panel B for the second stage. Predicted signs reported in Panels A of Tables 5 and 6 are as hypothesized and observed by Maskara and Mullineaux (2011a) in their study. For brevity, only results on 10-day windows for changes in short-term IV and TSIV are reported in Panels B of Tables 5 and 6.

Insert Tables 5 and 6 about here.

We observe from Panel A of both Tables 5 and 6 that the signs and statistical significance of factors making a loan announcement by the borrowing firm more vs. less probable generally conform to the ones observed by Maskara and Mullineaux (2011a) using a random sampling technique for loan identification, but this time for the universe of firms with data on Compustat, Optionmetrics and Dealscan (with the exception of the lack of significance for the loss indicator in Panel A of Table 6). Findings from Panels A indicate that it is significantly more probable for a loan to be announced if a firm faces larger information asymmetry, or is experiencing a loss in the fiscal year, or the loan represents a higher proportion of the borrowing firm's assets.

The results in Panel B, Tables 5 and 6, indicate a significant association between market-wide volatility levels and changes, for which relevant returns of the VIX index are used as a proxy, and the firm-specific levels and changes in short-term IV and the TSIV around bank loan events, although relevant results are stronger for short-term IV compared to the TSIV. Moreover, the inverse Mill's ratio (IMR_i) that is produced by the first stage of the Heckman (1979) procedure and accounts for the potential omitted variable problem caused by the non-random nature of our loan announcements appears statistically significant in virtually all specifications, providing some reassurance for the appropriateness of our approach.

Furthermore, we observe from Panel B of Table 5 a positive association between leverage and short-term IV changes (but not levels) as of the day of bank loan announcements, with the exception of the [-10,0] event window. At the same time, changes (but again not levels) in short-term IV are found to be stronger as firm size decreases and operating cash flow volatility increases, with this last result to also hold for short-term IV levels as well (at 1% significance level). We also observe a significantly negative association between profitability and asset tangibility and the level of short-term IV on the event day, indicating that volatility is higher for less profitable firms and firms with fewer tangible assets, with no evidence of significance for these variables in the changes in volatility regressions. Regarding loan-specific variables, we find that short-term IV levels on the day of the loan announcement positively relate to whether a loan is secured and to the magnitude of the credit spread, while short-term IV levels significantly and negatively relate (at acceptable levels of significance) to the number of lenders of the loan, loan maturity, loan size, and credit rating, indicating higher uncertainty for loans of firms pledging more collateral in order to secure a loan, loans with higher spreads, and also loans of smaller borrowing firms, with larger lending syndicates to possibly diversify higher credit risk by borrowers, and loans with higher maturities. However, loan size appears to be the only loan-specific variable consistently (positively) relating to changes in short-term IV, with very limited evidence for the number of lenders and loan maturity, and no such evidence for senior debt credit rating or loan spread, upon including controls for a number of other loan-specific variables.

We additionally observe from Panel B of Table 6 that firm size and asset tangibility significantly negatively (positively) associated with changes in slope of the TSIV before loan announcement events (between minus 10 and zero days), and further significantly associated with higher resolutions TSIV slope after the event has taken place in the case of size. There is further observed a negative (positive) link between firm size (asset tangibility) and the slope of the TSIX on the day of the event. However, there exists very limited and sporadic evidence regarding the statistical significance of other firm-specific factors (for example, in the case of cash flow volatility for the [0,+10] event window for changes regressions, or firm growth for the [-10,0] event window) for the determination of TSIV levels and changes around loan announcement events.[18]

As is the case in Panel B of Table 5 for short-term IV, we get evidence of a stronger statistical significance for loan-specific factors when we examine levels, rather than changes in the slope of the TSIV. The level of the TSIV significantly and positively relates to the probability that the loan has been secured and to loan size. Regarding changes in the TSIV, we get stronger evidence (for at least two time windows examined) only for a significant effect of loan size on TSIV slope changes, with an increasing effect on the slope before the event and a decreasing contribution to the slope afterwards. At the same time, we observe that loan security and size positively associate with changes in the slope of the TSIV on the day of the loan announcement event, while the number of lenders negatively (positively) relate to TSIV slope changes before (after) the event, while the exact opposite occurs for loan size, with limited evidence on the statistical significance of the other loan-specific factors for the TSIV regressions. In this way, TSIV changes appear to be significantly more intense (in absolute terms) depending on loan size and syndicate magnitude.

Our evidence from Tables 5 and 6 overall indicates that a considerable number of firm or loan-specific factors significantly associate with the level and changes of short-term IV and TSIV, as we

[18] Cash flow volatility is observed to negatively relate to changes in the TSIV for time windows around or after the loan announcement event, indicating stronger decreases in the slope of the TSIV curve for firms with lower cash flow volatility, or firms posing fewer concerns with respect to the historical variability of their operating cash flows.

observe that option markets tend to react more strongly to announcements by smaller firms, and by firms with lower profitability, higher historical cash flow volatility and leverage ratios, and this reaction further depends on loan size and number of lenders. This evidence is consistent with option markets reacting more sensitively to the announcement of loans which could result in larger material changes for borrowing firms, or loans of firms with fundamental characteristics inherently considered to be more risky, for example small size or high cash flow volatility. We consider that this evidence provides indications on a considerable degree of efficiency for option markets market efficiency, given that past evidence on the sensitivity of stock market reaction to firm or loan-specific characteristics using a similar regression setting has been quite weak (Byers et al., 2008).

Before leaving this section, it should be noted that the Heckman selection model we employ in our empirical investigation depends strongly on the model being correct (Guo and Fraser, 2014). Theory and evidence from past empirical investigations have little guidance to offer as to which covariates or proxies achieve correct identification (i.e. satisfy the exclusion requirement); a notable exception is the hypotheses and empirical findings of Maskara and Mullineaux (2011a) that have partly motivated our research, where it is established that (a) information asymmetry and (b) large loan size (when compared to the firm's asset base) are key proxies in identifying 'announcing' against 'non-announcing' bank borrowing firms in their sample. Hence our implementation of the Heckman selection model follows their lead by employing $IA_{i,t}$, $TRANCHE_{i,t}/TA_{i,t}$ and $LOSS_{i,t}$ in the first stage equation. Whether one, two, all or none of these proxies achieve correct identification is an issue that, in the absence of theory, can only be argued and examined empirically. Given the importance of this choice for our empirical framework in this section, we have conducted repeated estimations of (3)-(4), where now only one independent variable from (3) (i.e. only $IA_{i,t}$ in one specification, $TRANCHE/TA_{i,t}$ in a second, etc.) does not appear in (is excluded from) the second-stage equation (4). Results from these alternative specifications of the Heckman model, which are unreported in the sake of brevity but are made available from the authors upon request, are qualitatively similar, in that firm size, profitability, historical cash flow volatility and leverage continue to appear as the most important firm-specific determinants of implied volatility dynamics around firm loan announcements, and this further depends on the size of the loan announced and the number of lenders involved. Furthermore, experiments (unreported) that employ in equation (3) alternative identifying covariates, other than those in Maskara and Mullineaux (2011a) (such as the interest coverage ratio that captures whether the borrower faces higher prospects of cash flow problems, making it more probable to announce a new loan) leave the estimates of equation (4) and conclusions reached largely unaffected.

4. The economic significance of the option market reaction around firm loan announcements

The findings of our event study in Section 2 establish the statistical significance of IV and TSIV changes around loan announcements that are initiated by borrowing firms. We find statistically significant decreases of short-term equity implied volatility, and significant increases in the slope of the implied volatility term structure around the loan announcement day, and by their magnitude the reported increases/decreases seem to be material in an economic sense.

In order to provide further evidence on the economic significance of the event study findings, we conduct in this Section an (in-sample) trading strategy that is based on the findings of the IV and TSIV changes around the announcement day. Given that firm loan announcements are largely unanticipated events, we concentrate only on trading strategies that can be implemented after the actual announcement by the firm, thus not dealing with the possibility that the imminent announcement has entered the information set of investors or (firm and bank) insiders.

More specifically, given that short-term, at-the-money implied volatility from equity options is found to decrease significantly, on average, in the ten days following the announcement day (see Table 2), while the term structure of at-the-money implied volatility increases over the same time window, one way to exploit the findings of this study for trading purposes would be to 'go long' (buy) equity options of longer maturities following the loan announcement, while at the same time 'going short' (selling) the short-term option contracts.

The trading strategy, termed strategy A, is implemented as follows: whenever a new loan facility is announced by our sample firms, we invest $500 by going long at-the-money straddles on its stock with a longest available expiry. This investment is financed by selling (shorting), the same day, the necessary number of at-the-money straddles with a short-term expiry (30 days). The position is maintained for 10 trading days and then closed by taking reverse positions.[19] Concentrating on straddles allows one to focus trading solely on the effect of changes in (implied) volatility of the underlying asset, and the strategy is self-financed in that no own investment of funds is required. The strategy is repeated for all loan facility announcements made by sample firms.

To avoid market microstructure issues and to account for the possibility that an announcement can be made after trading hours, we conduct an alternative trading strategy, termed strategy B, where the

[19] A straddle is a combination of a call option and a put option on the same underlying asset, with the same maturity and strike price. If an announcement is made during the weekend or a holiday (52 announcements), the strategy is executed from the next trading day onwards.

same trades are executed but over the [+1, +10] day window relative to the announcement day. This is exactly as strategy A, under the restriction that the announcement day is 'missed'.[20]

Before turning to the results of the two strategies, three important notes are in order: First of all, although up to now we have been reporting results using the 'delta-interpolated' implied volatility levels and slopes for convenience, the actual (not averaged, not interpolated) call and put option prices and implied volatilities are used in calculating the position costs and profits for the trading strategies. Secondly, to keep the reported numbers as simple as possible, the option contract 'multipliers' (100 shares of the underlying stock) are ignored in calculating both the costs and profits of the strategy (as their effect is neutral). Finally, it should be noted that margin requirements and margin calls for uncovered short positions have been ignored in the calculations.[21]

The profits/losses of the trading strategies A and B are reported on Table 7, Panels A and B respectively, under the assumption of no transaction costs. Both strategies yield significant profits in total and on average as the last column of the Table indicates. Strategy A yields a sum of $21,072.43 in profit, with 53.12% of the 2,541 total trades executed being profitable. The mean profit is $8.32 (i.e. 1.66% return on the self-financed average position size of $500) and the median profit is $5.50 (i.e. 1.10% return on the $500 position size). Both the mean ($8.32) and median ($5.50) profits are statistically significant at the 1% significance level. The profits are driven by the 'long leg' of the strategy (buying straddles on long-term expiries when the announcement is made to exploit the increase in the term structure), as the profits of the strategy 'short leg' (selling straddles on short-term expiries) appear fairly negatively skewed (yielding significant profits only in median terms). Abstaining from trading on the loan announcement day (Strategy B) seems to introduce more skeweness to the profits of both strategy 'legs', making the overall profits higher, but only significant in means (average profit of $12.89; 2.58% in relative terms).

Insert Table 7 about here.

To assess the performance of the strategy in the presence of transaction costs, we repeat the trading exercise by imposing the following fee structure (ignoring the 'multiplier' again): $0.12 total fee for up to 5 contracts traded, $0.20 total fee for up to 10 contracts traded, $0.50 total fee for up to 50

[20] Again, for strategy B, for all announcements made during the weekend or a holiday, the strategy is executed from the next trading day onwards.

[21] If one were to include the 'multiplier', the long positions initiated would cost 100 times more, but also 100 times more would be the proceeds from the short positions. Moreover, note that by ignoring margin calls for uncovered short positions, our results ignore occasions where the investor would have to finance the maintenance of the margin account level over the 10-day horizon out of her own pocket.

contracts traded and $0.75 total fee for trading 100 contracts and above.[22] Results appear in Table 8 and are essentially largely unaffected by trading expenses. Profits are diminished by transaction costs but the strategies continue to yield statistically significant mean profits of $6.83 (1.37% for strategy A) and $11.40 (2.28% for strategy B), attributed mainly to the long positions initiated.

Insert Table 8 about here.

The findings of our trading strategies in this Section cannot be considered as evidence of inefficiency in the options market as several issues not explicitly addressed (market microstructure, margin call requirements) could diminish the magnitude of the profits reported. For example, the strategies' average profits are well-within the bid-ask spreads that an investor in the option market would face, and these are not accounted for in this Section.[23] However, the objective of this trading exercise is mainly to establish the economic (in addition to the statistical) significance of the option market reaction, as manifested by implied volatility, to loan announcements and the results of Tables 7 and 8 seem to accomplish that.

5. Conclusion

This study contributes to the literature by being the first that examines the option market reaction to bank loan announcements made by NYSE, AMEX, and NASDAQ listed firms during 1996-2010. Past research has examined the stock market reaction to firm loan announcements, by using random sampling techniques in order to construct a representative sample of loans from the population, reaching contrasting conclusions, possibly due to the 'self-selectivity' of loan announcements by listed firms.

The reaction of the options market, although it has been shown to lead the stock market in several respects, has been neglected by previous research, and our study fills this gap by establishing that there are statistically significant decreases of short-term implied volatility, and significant increases in the slope of the implied volatility term structure around the loan announcement days. Importantly, our

[22] By total fee, the sum of any base fee plus the per-contract fee is meant. The fee structure imposed is essentially the average from ten different brokers through which an individual investor could trade.

[23] Phillips and Smith (1980) identify the bid-offer spread as the largest cost facing option investors. Although options exchanges only set *upper limits* for the bid-ask spreads, which may range from $0.25 to $1.00 per transaction (see Hull, 2003), the *actual quoted* or *effective bid-offer* spreads at which investors trade equity options are below that, but still substantial. For example, in his study on the liquidity of the CBOE equity options, Vijh (1990) reports an average bid-ask spread of 21.3 cents, with less than 1.5% of the bid-ask spreads in his sample ever exceeding 50 cents. The study by Amin and Lee (1997), that reports an average effective bid-ask spread of 16.6 cents on equity option trades surrounding earnings announcement, offers an example of an equity option trading strategy with statistically significant profits, which turn to losses once the bid-ask spreads are accounted for (see Amin and Lee, 1997, Table 5 and the discussion that follows it).

study bases its entire analysis not on a representative sample of loans, but on *all loans and announcements* (manually-collected from Lexis/Nexis) made by *all firms* with data on Compustat and Optionmetrics and bank loan facility data on Dealscan, a data collection process that yields the population of firms with equity options traded that made a loan announcement between 1996 and 2010.

Our empirical investigation, that explicitly accounts for the selectivity of firm-initiated loan announcements, shows that the main findings (i.e. significant decreases in short-term implied volatility and significant increases in the slope of the implied volatility term structure around the loan announcement days) appear more pronounced for loans by firms which could be considered to be facing more information asymmetries or possess fundamental characteristics traditionally linked to greater risk e.g. smaller size, or cash flow volatility. Our findings are consistent with the view that loan announcements provide significant reassurance for investors in the short-term (due to the monitoring role that loan issuing banks can play); however, over longer time horizons, the increase in the slope of implied volatility term structure would indicate that investors become increasingly unsure over borrowing firm prospects in the long-run, for example, regarding the likelihood of loan repayment or the use of the proceeds.

We consider that our study also indirectly contributes to on-going discussion on the nature of firm loan announcements by establishing that, for the options market, such announcements are indeed economically significant and exploitable, through a profitable trading strategy that is based on our main findings.

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Appendix A

This Appendix contains variable definitions for firm and loan-specific variables (Compustat items in parentheses).

Financial Variable	**Description**	**Compustat/Dealscan item calculation**
	Firm-specific variables	
Information asymmetry index - IA	Composite index based on four information asymmetry benchmarks: analyst forecast errors, dispersion in analysts' forecasts, residual volatility of stock returns, and bid-ask spreads, based on Maskara and Mullineaux (2011a) and Gomes and Phillips (2010). Following Maskara and Mullineaux (2011a) and Gomes and Phillips (2010), the information asymmetry index is the average quintile ranking of the borrowing firm based on the four information asymmetry measures. These measures are calculated for the sample firms for each year, and firms are grouped into quintiles for all the firms in the year a loan is announced, in order to avoid the effect of secular trends in the measures over time, following Maskara and Mullineaux (2011a). Forecast error is equal to the absolute difference between analysts' forecasted earnings and actual earnings per share in the month prior to the annual earnings announcement. Dispersion of analyst opinions is equal to the standard deviation of analysts' forecasts of annual EPS in the last month prior to the earnings announcement. Both the forecast error and volatility variables are standardized by share price. Residual volatility in daily stock returns is the standard deviation of market-adjusted daily stock returns in the year of the loan announcement (bid- ask spreads measured as the average ratio of the difference between the daily bid and ask closing prices to the midpoint of the bid and ask closing prices, following Maskara and Mullineaux (2011a) and Chung and Zhang (2009), by imposing the requirement for at least 100 observations per year to calculate spread an residual volatility). Information on analyst forecasts has been retrieved by IBES, while information on stock returns from CRSP.	
LOSS	Loss indicator, equal to 1 if Net Income before Extraordinary Items and Preferred Dividends is negative, and 0 otherwise	1 if (#18) <0, and 0 otherwise
Loan-to-Asset ratio (TRANCHE/TA)	Loan tranche size scaled by Total Assets as of the year of the facility active date	Dealscan item '*Tranche Amount (Converted) ($)*'/(#6)
Ln MVE	Natural logarithm of annual market value of equity as of the year of the facility active date. Market value is calculated by multiplying the closing price at fiscal year-end by the number	Log (#199*#25)

	shares outstanding	
. LnTA	Natural logarithm of annual Total Assets in million dollars as of the year of the facility active date	Log(#44)
GPPE/TA	Annual Gross value of Property, Plant and Equipment, scaled by Total Assets, as of the year of the facility active date	(#7)/(#6)
Lev	Annual leverage ratio, or Total Debt (sum of short and long term debt), divided by Total Assets, as of the year of the facility active date	((#34 +#9)/ (#6))
NIBE/TA	Annual Net Income before Extraordinary Items and Preferred Dividends scaled by Total Assets, as of the year of the facility active date	(#18)/(#6)
BtoM	The book-to-market ratio used as a proxy for firms' growth opportunities, as of the year of the facility active date. Market value is calculated by multiplying the closing price at fiscal year-end by the number shares outstanding,	((#60)/(#199*#25))
Vol(CFO/TA)	Volatility of CFO, or standard deviation of yearly cash flows from operations over the past 5 years, scaled by annual Total Assets as the year of the facility active date	(StDev of #108)/(#6)
VIX (or Δln(VIX))	The return of the VIX index for time windows identical as the ones used for the definition of the return variable, for both levels and changes in IV and the TSIV	-
Industry Indicators	Industry dummy variables according to 2-digit industry SIC codes	-
	Loan-specific variables	
Secured	Secured loan indicator, or taking value of 1, if Dealscan variable Secured/Unsecured=' *Secured*', and 0 otherwise	Dealscan item '*Secured/Unsecured*'
LnNoLenders	Natural logarithm of the tranche number of lenders, as given by Dealscan	Dealscan item '*Number of Lenders*'
LnMaturity	Facility (tranche) maturity, equal to the natural logarithm of loan maturity in months, as given by Dealscan	Dealscan item 'Tenor/ Maturity'
LnTrancheSize	Facility (tranche) size, equal to the natural logarithm of loan tranche size in USD, as given by Dealscan	Dealscan item '*Tranche Amount (Converted) ($)*'
LnSpread	Loan tranche spread over basic rate, equal to the natural logarithm of Dealscan item *'All-in Spread Drawn'*	Dealscan item '*All-in spread Drawn*'
Rating	Ordinal variable taking values from 1 to 6, depending on the credit rating of the firm (in descending order). There is made use of the Dealscan item for ratings at the end of the loan, following Qian and Strahan (2007). There is made use of the Moody's or S&P (if Moody's rating data is not available, then data is complemented by using relevant S&P data, in case available) for senior debt ratings (Qian and Strahan, 2007). The variable takes the value of 1 if senior debt rating = Aaa (or the S&P equivalent), 2 for	Dealscan item '*Ratings-All At Close*'

	ratings until Aa3, 3 for rating values below Aa3 but above A3 (inclusive), 4 for a ratings below A3 but higher than Baa3 (inclusive), 5 for a rating lower than Baa3 but higher than Ba3 (inclusive) and 6 for a rating below Ba3. The variable is set equal to 0 if an abovementioned rating does not exist. Loan facilities with *Rating* = 1,2,3,4 are considered to be of Investment grade, while *Rating* values of 5 and 6 are considered to be of Speculative grade.	
Type	Facility (tranche) type categorical variable, taking different values depending on the Specific Tranche Type reported by Dealscan for the tranche in question	Dealscan item '*Specific Tranche Type*'
Type: Term loan	Referring to facilities (tranches) representing term loans	Dealscan item '*Specific Trance Type*' = Term loan, or Term Loan A, B, C….K, or Delay Draw Term Loan, or Revolver/Term Loan
Type: Credit line	Referring to facilities (tranches) representing credit lines	Dealscan item 'Specific Trance Type' = 364-Day Facility, or Demand Loan, or Limited Line, or Revolver/Line < 1 Yr. or Revolver/Line >= 1 Yr. The definition of credit lines is based on Lim et al. (2014)
Type: Acquisition facility	Referring to facilities (tranches) representing acquisition facilities	Dealscan item '*Specific Tranche Type*'= Acquisition Facility
Type: Bridge loan	Referring to facilities (tranches) representing bridge loans	Dealscan item '*Specific Tranche Type*'= Bridge Loan
Type: CAPEX facility	Referring to facilities (tranches) representing capital expenditure (CAPEX) facilities	Dealscan item '*Specific Tranche Type*'= CAPEX Facility
Purpose	Facility (tranche) purpose categorical variable, taking different values depending on the Primary Purpose reported by Dealscan for the tranche in question	Dealscan item '*Primary Purpose*'
Purpose: Acquisition line	Facility (tranche) primary purpose is to constitute an acquisition line	Dealscan item '*Primary Purpose*' = Acquis. line
Purpose: Capital expenditure	Facility (tranche) primary purpose is to fund capital expenditures	Dealscan item '*Primary Purpose*' = Capital expend.
Purpose: Corporate purposes	Facility (tranche) primary purpose is to fund corporate purposes	Dealscan item '*Primary Purpose*' = Corp. purposes
Purpose: Credit enhancement	Facility (tranche) primary purpose is to provide credit enhancement	Dealscan item '*Primary Purpose*' = Cred Enhanc.
Purpose: Debt repayment	Facility (tranche) primary purpose is to fund debt repayment	Dealscan item '*Primary Purpose*' = Debt Repay.
Purpose: Takeover	Facility (tranche) primary purpose is to fund a takeover	Dealscan item '*Primary Purpose*' = Takeover
Purpose: Working capital	Facility (tranche) primary purpose is to fund working capital requirements	Dealscan item '*Primary Purpose*' = Work. cap.

Table 1: Sample Descriptive Statistics – Loan-specific variables. The table reports summary statistics for a number of fundamental loan characteristics for the population of loan facilities (as defined in Section 3.1; loan facilities from the Dealscan database, with accounting data on Compustat and options data in Optionmetrics during 1996-2010). The Table reports in Panel A statistics using Dealscan data on the number or lenders (*NoLenders*), facility maturity (*Maturity*, in months), facility spread (*Spread*), facility size (*TrancheSize*, in U.S. $ millions), and facility size scaled by Total Assets (*Loan-to-Asset ratio*, using Compustat item #6 for the denominator). Panel B of the Table reports information on the fraction of facilities which are secured (*Secured*), and also facility type (*Type*), purpose (*Purpose*), and senior debt credit rating for issuing firms (*Credit Rating* – for unrated firms and in the case of firms with an existing rating, from highest (1) to lowest (6)). All data are reported at the facility level, following Qian and Strahan (2007), Kim et al. (2011), and Ferreira and Matos (2012), for all sample facilities, as well as facilities announced by the firm, or by any party separately (following the sample definition described in Section 3.1). Detailed variable definitions are reported in Appendix A.

Panel A: Loan-specific data – fundamental characteristics

Variables	Q1	Mean	Median	Q3	St. Dev.	No. Obs.
Loan facilities announced by firm						
NoLenders	4.0	9.8	8.0	13.0	9.3	2,891
Maturity (in months)	36.0	51.1	60.0	60.0	23.6	2,833
Spread	100.0	206.6	175.0	275.0	142.6	2,642
TrancheSize (in U.S. $ mil.)	100	426	200	500	829	2,896
Loan-to-Asset ratio	0.064	0.153	0.122	0.211	0.122	2,826
All announced loan facilities						
NoLenders	4.0	10.5	8.0	14.0	9.9	5,413
Maturity (in months)	36.0	50.7	60.0	60.0	25.3	5,284
Spread	87.5	195.4	175.0	275.0	139.1	4,955
TrancheSize (in U.S. $ mil.)	100	500	250	500	1,030	5,422
Loan-to-Asset ratio	0.061	0.145	0.114	0.198	0.116	5,227
All loan facilities						
NoLenders	3.0	9.4	7.0	13.0	9.6	12,887
Maturity (in months)	20.0	45.8	48.0	60.0	28.1	12,135
Spread	60.0	162.9	125.0	238.0	134.6	11,213
TrancheSize (in U.S. $ mil.)	100	489	225	500	943	12,928
Loan-to-Asset ratio	0.044	0.122	0.090	0.168	0.113	12,478

Panel B: Loan-specific data – security, type, purpose and credit rating

	Loans announced by firm		All announced loans		All loans	
Loan Secured	No. Obs.	%	No. Obs.	%	No. Obs.	%
Yes	1,215	41.95	2,539	46.83	7,896	61.08
No	1,681	58.05	2,883	53.17	5,032	38.92
Loan Type	No. Obs.	%	No. Obs.	%	No. Obs.	%
Acquisition	2	0.07	4	0.07	11	0.09
Bridge Loan	54	1.86	127	2.34	288	2.23
Term Loan	769	26.55	1,459	26.91	2,824	21.85
Credit Line	1,927	66.54	3,558	65.62	8,875	68.65
All other types	144	4.98	274	5.06	930	7.18
Loan Purpose	No. Obs.	%	No. Obs.	%	No. Obs.	%
Acquisition	108	3.73	239	4.41	513	3.97
Capital Expenditure	19	0.66	24	0.44	67	0.52
Corporate Purposes	1,090	37.64	1,763	32.52	4,716	36.48
Credit Enhancement	0	0.00	0	0.00	8	0.06
Debt Repayment	449	15.50	815	15.03	1,755	13.58
Takeover	280	9.67	828	15.27	1,423	11.01
Working Capital	727	25.10	1,089	20.08	2,136	16.52
All other purposes	223	7.70	664	12.25	2,310	17.86
Credit Rating	No. Obs.	%	No. Obs.	%	No. Obs.	%
Unrated	1,087	37.53	1,847	34.06	4,602	35.60
1	6	0.21	12	0.22	100	0.77
2	6	0.21	43	0.79	323	2.50
3	105	3.63	322	5.94	1,515	11.72
4	344	11.88	779	14.37	2,294	17.74
5	714	24.65	1,291	23.81	2,246	17.37
6	634	21.89	1,128	20.80	1,848	14.29
Total	2,896	100%	5,422	100%	12,928	100%

Table 2: Sample Descriptive statistics – Firm-specific Variables. The table reports summary statistics for a number of firm-specific variables for the population of loan facilities (as this is defined in Section 3.1, from the loans in the Dealscan database issued to firms with accounting data on Compustat and options data in Optionmetrics between 1996 and 2010. The Table reports statistics using Compustat data on firm size (natural logarithm of Total Assets - $Ln(TA)$), asset tangibility ($GPPE/TA$), leverage (Lev), profitability ($NIBE/TA$), the book-to-market ratio ($BtoM$), and cash flow volatility ($Vol(CFO/TA)$ – calculated using data from the last five years). The Table also reports data on short-term ATM option implied volatility σ_τ on day τ relative to the firm's quarterly earnings announcement date (day 0), changes in short-term implied volatility, $\Delta\sigma_{[x,y]}$ standing for the difference $\sigma_x - \sigma_y$, calculated for 10 and 1-day windows around the event of loan announcement, β_τ or implied volatility term structure calculated from delta-interpolated, at-the-money options on day τ relative to a firm's quarterly earnings announcement date (day 0), and $\Delta\beta_{[x,y]}$ equal to the slope difference $\beta_x - \beta_y$ calculated for 10 and 1-day windows around the event of loan announcement. The Table finally reports information on an information asymmetry index (*IA*) calculated according to Maskara and Mullineaux (2011a) and also Leary and Roberts (2010), Gomes and Phillips (2010) and Chung and Zhang (2009). This index makes use of information on *Analyst dispersion*, *Analyst forecast error, Bid-Ask spreads,* and *Stock return residual volatility*, and relevant data are reported in a continuous form and also in rank form (in this last case on a variable basis as well as using an aggregate measure, *IA*). All data are reported at the facility level, following Qian and Strahan (2007), Kim et al. (2011), and Ferreira and Matos (2012), as well as facilities announced by the firm (Panel A), or by any party (Panel B) and finally for all sample facilities (Panel C), following the sample definition described in Section 3.1. Detailed variable definitions are reported in Appendix A.

Panel A: Loan facilities announced by firm

Variables	Q1	Mean	Median	Q3	St. Dev.	No. Obs.
Loan facilities announced by firm						
Control Variables						
$Ln(TA)$	6.381	7.425	7.384	8.399	1.471	2,826
$GPPE/TA$	0.266	0.610	0.555	0.865	0.436	2,805
Lev	0.206	0.349	0.327	0.464	0.226	2,758
$NIBE/TA$	-0.004	0.008	0.030	0.063	0.140	2,826
$BtoM$	0.274	0.533	0.459	0.705	0.836	2,813
$Vol(CFO/TA)$	0.020	0.047	0.034	0.057	0.045	2,822
Short-term implied volatility						
σ_0	0.330	0.497	0.435	0.603	0.251	2,598
$\Delta\sigma_{[-1,0]}$	-0.017	-0.004	-0.002	0.011	0.129	2,591
$\Delta\sigma_{[-1,+1]}$	-0.024	0.065	-0.004	0.012	2.457	2,591
$\Delta\sigma_{[0,+1]}$	-0.017	0.069	-0.001	0.010	2.431	2,594
$\Delta\sigma_{[-10,0]}$	-0.030	0.006	-0.001	0.033	0.129	2,580
$\Delta\sigma_{[-10,+10]}$	-0.049	-0.001	-0.007	0.034	0.134	2,566
$\Delta\sigma_{[0,+10]}$	-0.036	-0.007	-0.005	0.023	0.141	2,580
Implied volatility term structure						
β_0	-0.090	0.047	-0.021	0.012	2.685	2,576
$\Delta\beta_{[-1,0]}$	-0.015	0.095	0.002	0.027	2.591	2,566
$\Delta\beta_{[-1,+1]}$	-0.015	-0.105	0.004	0.036	4.076	2,565
$\Delta\beta_{[0,+1]}$	-0.016	-0.123	0.001	0.025	2.837	2,570
$\Delta\beta_{[-10,0]}$	-0.041	0.092	0.000	0.041	2.775	2,557
$\Delta\beta_{[-10,+10]}$	-0.049	0.016	0.005	0.062	0.833	2,538
$\Delta\beta_{[0,+10]}$	-0.037	-0.076	0.003	0.048	2.831	2,553

Information asymmetry proxies-Level						
Analyst dispersion	0.010	0.060	0.030	0.060	0.115	2,255
Analyst forecast error	0.001	0.021	0.002	0.007	0.185	2,300
Bid-Ask spread	0.001	0.007	0.002	0.009	0.010	2,733
Stock return residual volatility	0.018	0.029	0.024	0.035	0.015	2,738
Information asymmetry proxies-Rank						
Analyst dispersion	1.000	2.889	3.000	4.000	1.571	2,402
Analyst forecast error	2.000	3.208	3.000	5.000	1.413	2,499
Bid-Ask spread	2.000	3.063	3.000	4.000	1.351	2,733
Stock return residual volatility	2.000	3.111	3.000	4.000	1.310	2,738
IA	2.250	3.100	3.000	3.750	1.007	2,745

Panel B: All announced loan facilities

Variables	Q1	Mean	Median	Q3	St. Dev.	No. Obs.
All announced loan facilities						
Control Variables						
$Ln(TA)$	6.559	7.625	7.536	8.669	1.484	5,227
$GPPE/TA$	0.263	0.594	0.539	0.855	0.415	5,192
Lev	0.219	0.360	0.341	0.469	0.230	5,101
$NIBE/TA$	0.000	0.013	0.032	0.064	0.136	5,227
$BtoM$	0.261	0.513	0.448	0.683	0.736	5,205
$Vol(CFO/TA)$	0.019	0.043	0.032	0.052	0.041	5,218
Short-term implied volatility						
σ_0	0.322	0.487	0.427	0.584	0.265	4,901
$\Delta\sigma_{[-1,0]}$	-0.016	-0.004	-0.001	0.010	0.192	4,885
$\Delta\sigma_{[-1,+1]}$	-0.023	0.031	-0.003	0.012	1.800	4,883
$\Delta\sigma_{[0,+1]}$	-0.015	0.035	-0.001	0.010	1.781	4,888
$\Delta\sigma_{[-10,0]}$	-0.031	0.002	-0.001	0.031	0.167	4,870
$\Delta\sigma_{[-10,+10]}$	-0.047	-0.004	-0.006	0.036	0.173	4,826
$\Delta\sigma_{[0,+10]}$	-0.035	-0.007	-0.003	0.026	0.167	4,846
Implied volatility term structure						
β_0	-0.090	0.013	-0.025	0.011	2.050	4,846
$\Delta\beta_{[-1,0]}$	-0.016	0.073	0.001	0.025	1.983	4,826
$\Delta\beta_{[-1,+1]}$	-0.020	-0.042	0.003	0.034	3.023	4,819
$\Delta\beta_{[0,+1]}$	-0.017	-0.075	0.001	0.023	2.165	4,828
$\Delta\beta_{[-10,0]}$	-0.041	0.049	0.000	0.044	2.350	4,813
$\Delta\beta_{[-10,+10]}$	-0.046	0.012	0.005	0.061	1.276	4,762
$\Delta\beta_{[0,+10]}$	-0.036	-0.037	0.002	0.046	2.160	4,784
Information asymmetry proxies-Level						

Analyst dispersion	0.010	0.063	0.030	0.060	0.119	4,172
Analyst forecast error	0.001	0.058	0.002	0.006	1.238	4,239
Bid-Ask spread	0.001	0.008	0.003	0.011	0.011	5,111
Stock return residual volatility	0.018	0.028	0.024	0.034	0.014	5,125
Information asymmetry proxies-Rank						
Analyst dispersion	1.000	2.920	3.000	4.000	1.578	4,479
Analyst forecast error	2.000	3.131	3.000	4.000	1.406	4,615
Bid-Ask spread	2.000	2.922	3.000	4.000	1.351	5,111
Stock return residual volatility	2.000	2.949	3.000	4.000	1.322	5,125
IA	2.250	2.997	3.000	3.750	0.999	5,142

Panel C: All loan facilities

Variables	Q1	Mean	Median	Q3	St. Dev.	No. Obs.
All loan facilities						
Control variables						
$Ln(TA)$	6.675	7.815	7.717	8.991	1.610	12,480
$GPPE/TA$	0.277	0.597	0.538	0.853	0.400	12,407
Lev	0.197	0.336	0.317	0.437	0.220	12,095
$NIBE/TA$	0.008	0.022	0.038	0.073	0.141	12,475
$BtoM$	0.247	0.481	0.418	0.640	0.664	12,441
$Vol(CFO/TA)$	0.018	0.042	0.031	0.052	0.043	12,450
Information asymmetry proxies-Level						
Analyst dispersion	0.010	0.067	0.030	0.060	0.319	9,894
Analyst forecast error	0.001	0.130	0.002	0.005	9.613	9,995
Bid-Ask spread	0.001	0.008	0.004	0.012	0.010	12,260
Stock return residual volatility	0.017	0.027	0.023	0.033	0.015	12,291
Information asymmetry proxies-Rank						
Analyst dispersion	1.000	2.891	3.000	4.000	1.583	3.000
Analyst forecast error	2.000	2.983	3.000	4.000	1.409	3.000
Bid-Ask spread	2.000	2.693	3.000	4.000	1.325	3.000
Stock return residual volatility	2.000	2.711	3.000	4.000	1.366	3.000
IA	2.000	2.827	2.750	3.500	0.998	2.750

Table 3: Portfolio Analysis – Mean and Median IV and TSIV Values around Loan Announcements. The Table reports means and medians of at-the-money, short-term implied volatility levels σ_0, and also term structure of implied volatility levels β_0 on the loan announcement day (day 0) for all announcement over 1996-2010. The Table further reports means and medians of at-the-money, short-term implied volatility changes $\Delta\sigma_{[x,y]} = \sigma_x - \sigma_y$, and of changes in term structure of implied volatility $\Delta\beta_{[x,y]} = \beta_x - \beta_y$ over trading day intervals *[x,y]* relative to the sample firms' loan announcement date (day 0) during the same period. Implied volatility (IV) is calculated by 'delta-interpolating' between the implied volatility of the closest-to-the money call and put options available on day τ. Variable β_τ stands for slope of the term structure of implied volatility, with term structure calculated from at-the-money options with expiries ranging from 30 up to 730 days in cases. In Panel A, we report means and medians of volatility metrics for loans announced by the firms themselves, while in Panel B, we repeat our analysis for loan announcements made by any party. The calculation of short-term IV and the term structure of IV is described in Section 3.2. An *, **, *** indicates that the null is rejected at the 10%, 5% and 1% significance level respectively. An †, †† and ††† indicates that a z-test for the median (Wilcoxon signed rank test) is statistically significant at 10%, 5% and 1% level of significance respectively.

Panel A: Loans announced by firm

Window around the loan announcement day	Announcement day (Day 0)	[-10,+10]	[-10,0]	[0,+10]	[-1,+1]	[-1,0]	[0,+1]
Loans announced by firm							
Short-term IV, σ							
Average	0.4974***	-0.0013	0.0056**	-0.0073***	0.0647	-0.0043*	0.0689
t-stat	100.85	-0.50	2.22	-2.63	1.34	-1.69	1.44
Median	0.4350†††	-0.0066†††	0.0014†	-0.0049†††	-0.0041†††	-0.0022†††	-0.0015†††
z-val	44.15	-5.06	1.76	-6.02	-8.76	-5.58	-5.25
N	2,598	2,566	2,580	2,580	2,591	2,591	2,594
Term structure of IV, β							
Average	0.0473	0.0160	0.0922*	-0.0759	-0.1053	0.0948*	0.0373
t-stat	0.89	0.97	1.68	-1.35	-1.31	1.85	1.42
Median	-0.0212†††	0.0048†††	-0.0003	0.0033†††	0.0036†††	0.0024†††	0.0014†††
z-val	-18.81	3.41	0.06	3.61	7.98	5.72	3.98
N	2,576	2,538	2,557	2,553	2,565	2,566	2,570

Panel B: All announced loans

Window around the loan announcement day	Announcement day (Day 0)	[-10,+10]	[-10,0]	[0,+10]	[-1,+1]	[-1,0]	[0,+1]
All announced loans							
Short-term IV, σ							
Average	0.4873***	-0.0040*	0.0021	-0.0066***	0.0306	-0.0043	0.0349
t-stat	128.84	1.69	0.89	-2.74	1.19	-1.57	1.37
Median	0.4269†††	-0.0060†††	-0.0014	-0.0034†††	-0.0031†††	-0.0012†††	-0.0013†††
z-val	60.63	-5.70	-0.77	-5.82	-10.21	-5.80	-6.36
N	4,901	4,826	4,870	4,846	4,883	4,885	4,888
Term structure of IV, β							
Average	0.0127	0.0120	0.0494	-0.0369	-0.0418	0.0726**	0.0063
t-stat	0.43	0.65	1.46	-1.18	-0.96	2.54	0.60
Median	-0.0251†††	0.0046†††	-0.0001	0.0025†††	0.0027†††	0.0015†††	0.0011†††
z-val	-27.25	4.97	0.29	4.22	7.74	5.51	3.84
N	4,846	4,762	4,813	4,784	4,819	4,826	4,828

Table 4: Mean and Median IV and TSIV Values around Loan Announcements according Loan Characteristics. The Table reports portfolio means of at-the-money, 30-day implied volatility levels σ_τ, and changes $\Delta\sigma_{[x,y]} = \sigma_x - \sigma_y$, and also term structure of implied volatility levels β_τ and changes $\Delta\beta_{[x,y]} = \beta_x - \beta_y$ on day τ (for levels) or over trading day intervals *[x,y]* relative to the sample firms' loan announcement date (day 0) for all announced loans during 1996-2010, according to different loan characteristics. Implied volatility (IV) is calculated by 'delta-interpolating' between the implied volatility of the closest-to-the money x-day call and put options available on day τ. Variable β_τ stands for slope of the term structure of implied volatility, with term structure calculated from at-the-money options with expiries ranging from 30 up to 730 days in cases. Results in this Table have been calculated (where applicable) for all loans that have been announced by any party – by the firm or any other party. In Panel A, we separate loan facilities depending on whether they have been announced by the firm itself or by any party other than the firm, according to credit rating (investment grade vs. speculative grade or unrated senior debt), maturity (shorter or longer than two years), spread size (lower/higher than 150 basis points (bp)). In Panel B, we separate loan facilities according to firm information asymmetry, using the methodology proposed by Maskara and Mullineaux (2011a) for information asymmetry levels, from lowest (1) to highest (4). An *, **, *** indicates that the null is rejected at the 10%, 5% and 1% significance level respectively. There have been also calculated differences between means of facility portfolios depending on the criterion for portfolio formation each time, and an #, ##, ### indicates that the null hypothesis that means between portfolios of firms are equal is rejected at the 10%, 5% and 1% significance level respectively. Detailed variable definitions are reported in Appendix A.

Panel A: Option market reaction depending on different loan characteristics

	Announced by firm	Announced by all others	Diff.
	(1)	(2)	(2)-(1)
σ_0	0.4974***	0.4758***	-0.0217###
$\Delta\sigma_{[-10,+10]}$	-0.0013	-0.0071	-0.0057
$\Delta\sigma_{[-10,0]}$	0.0056**	-0.0018	-0.0075
$\Delta\sigma_{[0,+10]}$	-0.0073***	-0.0058	0.0015
$\Delta\sigma_{[-1,+1]}$	0.0647	-0.0079	-0.0725
β_0	0.0473	-0.0267	-0.0740
$\Delta\beta_{[-10,+10]}$	0.0160	0.0075	-0.0085
$\Delta\beta_{[-10,0]}$	0.0922*	0.0009	-0.0913
$\Delta\beta_{[0,+10]}$	-0.0759	0.0076	0.0835
$\Delta\beta_{[-1,+1]}$	-0.1053	-4.1570*	-4.0516#

	Rating: 1-4 Investment Grade	Rating: 5-6 Speculative Grade	Unrated	Diff.	Diff.	Diff.
	(1)	(2)	(3)	(2)-(1)	(3)-(1)	(3)-(2)
σ_0	0.3761***	0.4941***	0.5536***	0.1180###	0.1775###	0.0595###
$\Delta\sigma_{[-10,+10]}$	-0.0017	-0.0027	-0.0074*	-0.0010	-0.0056	-0.0047
$\Delta\sigma_{[-10,0]}$	0.0084	-0.0027	0.0044	-0.0111#	-0.0040	0.0071
$\Delta\sigma_{[0,+10]}$	-0.0103	-0.0005	-0.0122***	0.0097	-0.0019	-0.0117##
$\Delta\sigma_{[-1,+1]}$	0.1619	-0.0106**	-0.0032	-0.1725##	-0.1651#	0.0074
β_0	0.2204***	-0.0231	-0.0824***	-0.2435###	-0.3028###	-0.0593###
$\Delta\beta_{[-10,+10]}$	-0.0742	0.0291*	0.0491**	0.1033##	0.1233##	0.0199
$\Delta\beta_{[-10,0]}$	0.1983	0.0247	-0.0208	-0.1735#	-0.2190#	-0.0455##
$\Delta\beta_{[0,+10]}$	-0.2706**	0.0033	0.0707***	0.2740###	0.3413###	0.0673##
$\Delta\beta_{[-1,+1]}$	-0.2316	0.0084	-5.9678*	0.2400#	-5.7362#	-5.9762##

	Maturity At most 2 years	Maturity More than 2 years	Diff.
	(1)	(2)	(2)-(1)
σ_0	0.4928***	0.4827***	-0.0101
$\Delta\sigma_{[-10,+10]}$	0.0034	-0.0065**	-0.0099#
$\Delta\sigma_{[-10,0]}$	0.0068	-0.0002	-0.0070
$\Delta\sigma_{[0,+10]}$	-0.0033	-0.0068**	-0.0034
$\Delta\sigma_{[-1,+1]}$	-0.0225***	0.0431	0.0655##
β_0	-0.0415*	0.0304	0.0720#
$\Delta\beta_{[-10,+10]}$	-0.0399	0.0248	0.0647
$\Delta\beta_{[-10,0]}$	-0.0303	0.0723*	0.1026
$\Delta\beta_{[0,+10]}$	-0.0096	-0.0474	-0.0379
$\Delta\beta_{[-1,+1]}$	0.0521	-2.5100*	-2.5621#

	Loan spread At most 150 bp	Loan spread More than 150 bp	Diff.
	(1)	(2)	(2)-(1)
σ_0	0.4061***	0.5382***	0.1321###
$\Delta\sigma_{[-10,+10]}$	-0.0040	-0.0037	0.0003
$\Delta\sigma_{[-10,0]}$	0.0062	-0.0003	-0.0066
$\Delta\sigma_{[0,+10]}$	-0.0102**	-0.0039	0.0063
$\Delta\sigma_{[-1,+1]}$	0.1005	-0.0117***	-0.1122#
β_0	0.1078	-0.0386***	-0.1464##
$\Delta\beta_{[-10,+10]}$	-0.0186	0.0297*	0.0484
$\Delta\beta_{[-10,0]}$	0.1055	0.0178	-0.0877
$\Delta\beta_{[0,+10]}$	-0.1221	0.0118	0.1339#
$\Delta\beta_{[-1,+1]}$	-0.1360	-3.6615*	-3.5255#

Panel B: Option market reaction depending on different levels of firm information asymmetry

	Info Asymmetry $IA \leq 2$	Info Asymmetry $2 < IA \leq 3$	Info Asymmetry $3 < IA \leq 4$	Info Asymmetry $IA > 4$
	(1)	(2)	(3)	(4)
σ_0	0.3600***	0.4416***	0.5295***	0.6956***
$\Delta\sigma_{[-10,+10]}$	-0.0099	-0.0003	-0.0012	-0.0113
$\Delta\sigma_{[-10,0]}$	-0.0114*	0.0062*	0.0007	0.0041
$\Delta\sigma_{[0,+10]}$	0.0019	-0.0065**	-0.0020	-0.0165***
$\Delta\sigma_{[-1,+1]}$	-0.0198	-0.0066***	0.0769	0.0037
β_0	0.2634**	-0.0764***	-0.0282*	-0.0358
$\Delta\beta_{[-10,+10]}$	-0.1202*	0.0459**	0.0543*	0.0350***
$\Delta\beta_{[-10,0]}$	0.1725	-0.0030	0.0321*	0.0663**
$\Delta\beta_{[0,+10]}$	-0.2940**	0.0488***	0.0224	-0.0294
$\Delta\beta_{[-1,+1]}$	0.0589**	0.0368**	-0.1312	-0.0179

	Diff.	Diff.	Diff.	Diff.	Diff.	Diff.
	(2)-(1)	(3)-(1)	(4)-(1)	(3)-(2)	(4)-(2)	(4)-(3)
σ_0	0.0817###	0.1695###	0.3356###	0.0878###	0.2540###	0.1662###
$\Delta\sigma_{[-10,+10]}$	0.0096	0.0087	-0.0015	-0.0009	-0.0110	-0.0101
$\Delta\sigma_{[-10,0]}$	0.0176###	0.0121#	0.0155#	-0.0055	-0.0020	0.0034
$\Delta\sigma_{[0,+10]}$	-0.0085	-0.0039	-0.0184##	0.0046	-0.0100	-0.0146#
$\Delta\sigma_{[-1,+1]}$	0.0132	0.0967	0.0235	0.0835	0.0103	-0.0732
β_0	-0.3398###	-0.2915##	-0.2992##	0.0483##	0.0406	-0.0076
$\Delta\beta_{[-10,+10]}$	0.1662###	0.1745##	0.1553##	0.0083	-0.0109	-0.0192
$\Delta\beta_{[-10,0]}$	-0.1755	-0.1404	-0.1062	0.0351	0.0693#	0.0342
$\Delta\beta_{[0,+10]}$	0.3429###	0.3164##	0.2647#	-0.0265	-0.0782###	-0.0517
$\Delta\beta_{[-1,+1]}$	-0.0221	-0.1901	-0.0768##	-0.1680	-0.0547	0.1133

Table 5: Option Market Reaction to Loan Announcements: Regression Analysis for Short-Term IV. In Panel A, the Table reports estimation results of the following probit model that constitutes the selection equation of the Heckman (1979) procedure:

$$Pr\left[Announced\ by\ firm_{i,t} = 1\right] = \Phi(\gamma_0 + \gamma_1 IA_{i,t} + \gamma_2 TRANCHE/TA_{i,t} + \gamma_3 LOSS_{i,t} + \sum_k \gamma_{6,k} YearIndicator_{k,i,t} + e_{i,t}) = \Phi(\boldsymbol{z}_{i,t}\boldsymbol{\gamma} + e_{i,t})$$

The variable $Announced\ by\ Firm_{i,t}$ is a dummy variable that equals 1 if the loan facility i in year t was announced by the firm itself, and zero if the firm did not make such an announcement. Operators $Pr[.]$ and $\Phi(.)$ denote probability and the cumulative distribution function of the standard normal distribution respectively. All independent variables are as defined in Appendix A. The marginal effect is calculated as the change in $\Phi(\boldsymbol{z}_{i,t}\hat{\boldsymbol{\gamma}})$ when the variable in question in the vector of independent variables $\boldsymbol{z}_{i,t}$ changes by one, and all other variables are set at their mean values (all year indicators are set to zero in the marginal effects calculations). $LogL$ denotes the maximised log-likelihood and LR χ^2 stat. is the Likelihood Ratio Chi-Square test under the null hypothesis that at least one of the independent variables' coefficients is not equal to zero, and the test's p-value appears in square brackets. $Pseudo\ R^2$ is McFadden's measure of goodness of fit, computed as $1 - LogL/LogL_c$, where $LogL_c$ denotes the (constrained) log-likelihood of a model with an intercept only. Asterisks *, ** and *** indicate coefficient statistical significance at the 10%, 5% and 1% level respectively.

Panel A: Heckman (1979) selection equation estimation results for short-term IV (σ)				
	Pred. Sign	Coefficient	z-statistic	Marginal effect
Intercept		-1.3291***	-12.20	
$IA_{i,t}$	+	0.1791***	7.02	0.0612
$TRANCHE_i/TA_{it}$	+	1.4512***	9.17	0.4957
$LOSS_{i,t}$	+	0.1798***	3.37	0.0614
Year Indicators		Yes		
LR χ^2 stat.		805.14### [0.000]	$Pseudo\ R^2$	0.0743
No. Obs.		11,359	$LogL$	-5,015.72

In Panel B, the Table reports estimation results of the following equation that constitutes the response equation of the Heckman (1979) procedure:

$$\{\sigma_{i,\tau}, \Delta\sigma_{[\tau_1,\tau_2]}\} = \alpha_0 + \alpha_1 Market\ control_{i,t} + \sum_k \alpha_{2,k} Firm-specific\ controls_{k,i,t} + \sum_l \alpha_{3,l} Loan-specific\ variables_{l,i} + \alpha_4 IMR_{i,t} + \sum_k \alpha_{5,k} YearIndicator_{k,i,t} + \varepsilon_{i,t}$$

The dependent variables σ_τ and $\Delta\sigma_{(x,y)}$ are respectively short-term ATM option implied volatility σ_τ on day τ relative to the firm's loan announcement date (day 0), and the change in short-term implied volatility, $\Delta\sigma_{[x,y]}$ standing for the difference $\sigma_x - \sigma_y$, calculated for 10-day windows around the event of loan announcement. All independent variables are as defined in Appendix A. $IMR_{i,t}$ is the inverse of Mill's ratio (the non-selection hazard rate) from the first stage of the Heckman (1979) procedure, calculated as $\varphi(\boldsymbol{z}_{i,t}\widehat{\boldsymbol{\gamma}})/\Phi(\boldsymbol{z}_{i,t}\widehat{\boldsymbol{\gamma}})$, with $\varphi(.)$ the density and $\Phi(.)$ the cumulative density function of the standard normal distribution. z-statistic values are reported in parentheses, and asterisks *, ** and *** indicate statistical significance at the 10%, 5% and 1% level respectively. The Wald χ^2 statistic is a Wald test that all coefficients in the regression model (except the constant) are all equal to zero (and its *p-value* is reported in square brackets). $LogL$ denotes the maximized log-likelihood and $Pseudo\ R^2$ is McFadden's measure of goodness of fit, computed as $1 - LogL/LogL_c$, where $LogL_c$ denotes the (constrained) log-likelihood of a model with an intercept only.

Panel B: Estimation results for short-term IV – response equation of Heckman (1979) model				
Coefficients / Dependent Var.	$\sigma_{i,0}$	$\Delta\sigma_{i,[-10,+10]}$	$\Delta\sigma_{i,[-10,0]}$	$\Delta\sigma_{i,[0,+10]}$
Intercept	0.5150***	-0.2825***	-0.1856**	-0.3345***
	(3.55)	(-3.14)	(-2.53)	(-3.35)
$VIX_{i,0}$	0.9821***			
	(10.44)			
$\Delta ln([VIX_{[x,y]}])$		0.7733***	0.7046***	0.6857***
		(10.14)	(8.28)	(9.86)
$IMR_{i,t}$	-0.1477***	0.1657***	0.1164***	0.1314***
	(-9.31)	(7.28)	(7.34)	(6.42)
Firm-specific control variables				
$Ln(TA_{i,t})$	0.0116	-0.0202***	-0.0112***	-0.0183***
	(1.33)	(-3.53)	(-2.93)	(-4.06)
$GPPE_{i,t}/TA_{i,t}$	-0.0251*	0.0051	-0.0026	0.0098*
	(-1.94)	(0.61)	(-0.38)	(1.75)
$Lev_{i,t}$	0.0177	0.0406**	0.0026	0.0467***
	(0.55)	(2.36)	(0.16)	(2.77)
$NIBE_{i,t}/TA_{i,t}$	-0.3712***	-0.0308	-0.0551	0.0371
	(-5.73)	(-0.85)	(-1.63)	(1.03)
$BtoM_{i,t}$	-0.0009	-0.0011	-0.0075	0.0101**
	(-0.56)	(-0.13)	(-1.18)	(2.24)
$Vol(CFO_{i,t}/TA_{i,t})$	0.5106***	0.2633***	0.1505**	0.1205*
	(2.82)	(3.35)	(2.29)	(1.67)
Loan-specific variables				
$Secured_i$	0.0253**	-0.0051	-0.0029	0.0040
	(2.35)	(-0.71)	(-0.47)	(0.61)
$Ln(Lenders_i)$	-0.0202***	0.0085*	0.0033	0.0039
	(-2.94)	(1.86)	(1.02)	(1.08)
$Ln(Maturity_i)$	-0.0313**	-0.0097	0.0034	-0.0178**
	(-2.51)	(-1.40)	(0.68)	(-2.48)

$Ln(Tranche_i)$	-0.0231*** (-3.23)	0.0124** (2.55)	0.0064* (1.89)	0.0172*** (3.36)
$Ln(SPREAD_i)$	0.0623*** (5.66)	0.0071 (0.88)	0.0041 (0.65)	0.0033 (0.60)
$Rating_i$	-0.0046* (-1.71)	-0.0002 (-0.09)	0.0002 (0.12)	0.0002 (0.16)
$Type_i$	0.0011** (1.97)	-0.0002 (-0.83)	-0.0005* (-1.69)	0.0004 (1.02)
$Purpose_i$	-0.0000 (-0.11)	-0.0001 (-0.74)	0.0000 (0.27)	-0.0002 (-1.31)
Year Indicators	Yes	Yes	Yes	Yes
Wald χ^2 stat.	968.86### [0.000]	214.95### [0.000]	140.11### [0.000]	192.22### [0.000]
No. Obs.	2,087	2,062	2,066	2,070
$Pseudo\ R^2$	0.2398	0.1278	0.1224	0.1134
$LogL$	-4,130.4	-3,360.7	-2,949.3	-3,176.7
Variance-Inflation-Factor (VIF)				
$IMR_{i,t}$	5.3937	9.4251	9.5238	9.7752

Table 6: Option Market Reaction to Loan Announcements: Regression Analysis for TSIV. In Panel A, the Table reports estimation results of the following probit model that constitutes the selection equation of the Heckman (1979) procedure:

$$Pr[Announced\ by\ firm_{i,t} = 1] = \Phi(\gamma_0 + \gamma_1 IA_{i,t} + \gamma_2 TRANCHE/TA_{i,t} + \gamma_3 LOSS_{i,t} + \sum_k \gamma_{6,k} YearIndicator_{k,i,t} + e_{i,t})$$
$$= \Phi(\boldsymbol{z}_{i,t}\boldsymbol{\gamma} + e_{i,t})$$

The variable $Announced\ by\ Firm_{i,t}$ is a dummy variable that equals 1 if the loan facility i in year t was announced by the firm itself, and zero if the firm did not make such an announcement. Operators $Pr[.]$ and $\Phi(.)$ denote probability and the cumulative distribution function of the standard normal distribution respectively. All independent variables are as defined in Appendix 1. The marginal effect is calculated as the change in $\Phi(\boldsymbol{z}_{i,t}\hat{\boldsymbol{\gamma}})$ when the variable in question in the vector of independent variables $\boldsymbol{z}_{i,t}$ changes by one, and all other variables are set at their mean values (all year indicators are set to zero in the marginal effects calculations). $LogL$ denotes the maximised log-likelihood and LR χ^2 stat. is the Likelihood Ratio Chi-Square test under the null hypothesis that at least one of the independent variables' coefficients is not equal to zero, and the test's p-value appears in square brackets. $Pseudo\ R^2$ is McFadden's measure of goodness of fit, computed as $1 - LogL/LogL_c$, where $LogL_c$ denotes the (constrained) log-likelihood of a model with an intercept only. Asterisks *, ** and *** indicate coefficient statistical significance at the 10%, 5% and 1% level respectively.

Panel A: Heckman (1979) selection equation estimation results for TSIV (β)				
	Pred. Sign	Coefficient	z-statistic	Marginal effect
Intercept		-0.9188***	-13.56	
$IA_{i,t}$	+	0.0175**	2.12	0.0053
$TRANCHE_i/TA_{it}$	+	0.8423***	4.57	0.2550
$LOSS_{i,t}$	+	0.0181	1.61	0.0055
Year Indicators		Yes		
LR χ^2 stat.		801.62### [0.000]	$Pseudo\ R^2$	0.0744
No. Obs.		11,342	$LogL$	-4,988.62

In Panel B, the Table reports estimation results of the following equation that that constitutes the response equation of the Heckman (1979) procedure:

$$\{\beta_{i,\tau}, \Delta\beta_{[\tau_1,\tau_2]}\} = \alpha_0 + \alpha_1 Market\ control_{i,t} + \sum_k \alpha_{2,k} Firm - specific\ controls_{k,i,t} + \sum_l \alpha_{3,l} Loan - specific\ variables_{l,i} + \alpha_4 IMR_{i,t} + \sum_k \alpha_{5,k} YearIndicator_{k,i,t} + \varepsilon_{i,t}$$

The dependent variables β_τ and $\Delta\beta_{(x,y)}$ are respectively the implied volatility term structure β_τ, calculated from delta-interpolated, at-the-money options on day τ relative to a firm's loan announcement date (day 0), and the change in term structure $\Delta\beta_{[x,y]}$ equal to the slope difference $\beta_x - \beta_y$, calculated for 10-day windows around the event of the loan announcement. All independent variables are as defined in Appendix 1. $IMR_{i,t}$ is the inverse of Mill's ratio (the non-selection hazard rate) from the first stage of the Heckman (1979) procedure, calculated as $\varphi(\boldsymbol{z}_{i,t}\hat{\boldsymbol{\gamma}})/\Phi(\boldsymbol{z}_{i,t}\hat{\boldsymbol{\gamma}})$, with $\varphi(.)$ the density and $\Phi(.)$ the cumulative density function of the standard normal distribution. z-statistic values are reported in parentheses, and asterisks *, ** and *** indicate statistical significance at the 10%, 5% and 1% level respectively. The Wald χ^2 statistic is a Wald test that all coefficients in the regression model (except the constant) are all equal to zero (and its *p-value* is reported in square brackets). $LogL$ denotes the maximized log-likelihood and $Pseudo\ R^2$ is McFadden's measure of goodness of fit, computed as $1 - LogL/LogL_c$, where $LogL_c$ denotes the (constrained) log-likelihood of a model with an intercept only.

Panel B: Estimation results for TSIV – response equation of Heckman (1979) model				
Coefficients / Dependent Var.	$\beta_{i,0}$	$\Delta\beta_{i,[-10,+10]}$	$\Delta\beta_{i,[-10,0]}$	$\Delta\beta_{i,[0,+10]}$
Intercept	-5.9748***	-0.4314	-6.4197***	8.7333***
	(-3.49)	(-1.43)	(-4.25)	(3.536)
$VIX_{i,0}$	-0.6801***			
	(-5.20)			
$\Delta ln([VIX_{[x,y]}])$		-0.4739***	-0.2324	-0.4334
		(-2.71)	(-1.01)	(-1.12)
$IMR_{i,t}$	3.3743***	-0.0684*	3.5553**	-3.9072***
	(2.81)	(-1.71)	(2.57)	(-3.06)
Firm-specific control variables				
$Ln(TA_{i,t})$	-0.2239***	-0.0049	-0.2189***	0.3743***
	(-3.33)	(-0.23)	(-3.93)	(3.28)
$GPPE_{i,t}/TA_{i,t}$	0.1031**	0.0568	0.1165***	-0.0199
	(2.31)	(1.05)	(4.64)	(-0.23)
$Lev_{i,t}$	0.0424	-0.0396	-0.0132	-0.2960
	(0.64)	(-0.71)	(-0.14)	(-1.62)
$NIBE_{i,t}/TA_{i,t}$	-0.0720	-0.0049	0.0523	0.2911*
	(-0.84)	(-0.07)	(0.26)	(1.78)
$BtoM_{i,t}$	-0.0453	-0.0024	-0.0411***	0.0027
	(-1.29)	(-0.22)	(-2.72)	(0.10)
$Vol(CFO_{i,t}/TA_{i,t})$	0.3367	-0.2963*	0.2277	-1.0011**
	(1.46)	(-1.78)	(1.08)	(-2.44)
Loan-specific variables				
$Secured_i$	0.1153**	0.0560	0.1295*	0.0008
	(2.16)	(1.52)	(1.93)	(0.01)
$Ln(Lenders_i)$	-0.0306	0.0053	-0.0413***	0.0773*
	(-1.56)	(0.27)	(-2.80)	(1.81)
$Ln(Maturity_i)$	-0.0179	0.0231	-0.0037	0.0445
	(-0.71)	(1.26)	(-0.25)	(1.21)
$Ln(Tranche_i)$	0.2540***	0.0126	0.2476***	-0.3930***
	(3.72)	(0.77)	(4.97)	(-3.39)
$Ln(SPREAD_i)$	-0.0480	0.0244	-0.0113	0.0010
	(-1.22)	(0.80)	(-0.48)	(0.02)

$Rating_i$	0.0021 (0.36)	-0.0121 (-1.06)	-0.0096* (-1.86)	-0.0129 (-0.75)
$Type_i$	0.0005 (0.45)	-0.0005 (-0.48)	0.0003 (0.45)	-0.0029 (-1.07)
$Purpose_i$	0.0003 (0.30)	-0.0011 (-0.86)	0.0005 (0.68)	-0.0022 (-1.06)
Year Indicators	Yes	Yes	Yes	Yes
Wald χ^2 stat.	54.36### [0.003]	58.51### [0.001]	86.59### [0.000]	86.14### [0.000]
No. Obs.	2,070	2,040	2,048	2,049
$Pseudo\ R^2$	0.1183	0.1337	0.1499	0.1237
LogL	-8,270.8	-7,309.1	-8,358.7	-9,172.3
Variance-Inflation-Factor (VIF)				
$IMR_{i,t}$	4.2985	9.0253	4.2299	2.3626

Table 7: Trading results for an options strategy based on the term structure of implied volatility following firm loan announcements under no transaction costs The Table reports the sum, the mean and the median profits and losses of two trading strategies (strategies A and B) outlined in Section 4. In Panel A (B) the results of strategy A (B) are summarized. Strategy A is as follows: On the day a new loan facility is announced by a firm, we invest $500 by going long at-the-money straddles on its stock with the longest expiry available. This investment is financed by selling (shorting), on the same day, the necessary number of at-the-money straddles with the short-term expiry (30 days). The position is maintained for 10 trading days, and then closed. Strategy B is identical to A, only trades are implemented only the day following the loan facility announcement day. An *, ** and *** (respectively †, †† and †††) indicates a statistically greater from zero mean (median) at the 10%, 5% and 1% level respectively.

Panel A: Trading profits and losses under no transaction costs (Strategy A)

Trading Profits under No transaction costs		Strategy leg: Short position		Strategy leg: Long position		Strategy: Long and Short, *[0, +10]*	
		Profits ($)	% of profitable trades	Profits ($)	% of profitable trades	Profits ($)	% of profitable trades
Pooled:	Sum	1,762.01	53.04% of 2,541 trades	19,310.42	47.71% of 2,541 trades	21,072.43	53.12% of 2,541 trades
	Min	-1,440.77		-567.86		-1,115.28	
	Max	749.35		1,715.90		1,827.15	
	Mean	0.70		7.63***		8.32***	
	t-stat	(0.22)		(2.80)		(2.69)	
	Median	8.31†††		3.14†††		5.50†††	
	z-val	[2.56]		[2.10]		[3.30]	

Panel B: Trading profits and losses under no transaction costs for a strategy that starts on the day following the loan announcement day (Strategy B)

Trading Profits under No transaction costs		Strategy leg: Short position		Strategy leg: Long position		Strategy: Long and Short, *[+1, +10]*	
		Profits ($)	% of profitable trades	Profits ($)	% of profitable trades	Profits ($)	% of profitable trades
Pooled:	Sum	-8,164.68	49.94% of 2,541 trades	40,930.21	48.68% of 2,541 trades	32,765.53	50.61% of 2,541 trades
	Min	-2,112.58		-950.62		-1,470.01	
	Max	896.60		2,783.14		3,243.94	
	Mean	-3.21		16.11***		12.89***	
	t-stat	(-0.94)		(3.63)		(2.77)	
	Median	1.06		-1.72		0.00	
	z-val	[0.70]		[-0.06]		[0.40]	

Table 8 Trading results for an options strategy based on the term structure of implied volatility following firm loan announcements when transaction costs are imposed
The Table reports the sum, the mean and the median profits and losses of two trading strategies (strategies A and B) outlined in Section 4. In Panel A (B) the results of strategy A (B) are summarized. Strategy A is as follows: On the day a new loan facility is announced by a firm, we invest $500 by going long at-the-money straddles on its stock with the longest expiry available. This investment is financed by selling (shorting), on the same day, the necessary number of at-the-money straddles with the short-term expiry (30 days). The position is maintained for 10 trading days, and then closed. Strategy B is identical to A, only trades are implemented only the day following the loan facility announcement day. Transaction costs are as described in Section 4. An *, ** and *** (respectively †, †† and †††) indicates a statistically greater from zero mean (median) at the 10%, 5% and 1% level respectively.

Panel A: Trading profits and losses with transaction costs (Strategy A)

Trading Profits with transaction costs		Strategy leg: Short position		Strategy leg: Long position		Strategy: Long and Short, *[0, +10]*	
		Profits ($)	% of profitable trades	Profits ($)	% of profitable trades	Profits ($)	% of profitable trades
Pooled:	Sum	-136.49	52.80% of 2,541 trades	17,435.92	47.27% of 2,541 trades	17,299.43	52.41% of 2,541 trades
	Min	-1,441.52		-568.36		-1,116.78	
	Max	748.60		1,715.15		1,825.65	
	Mean	-0.05		6.89***		6.83**	
	t-stat	(-0.02)		(2.53)		(2.21)	
	Median	7.56††		2.58†		4.00†††	
	z-val	[2.26]		[1.53]		[2.59]	

Panel B: Trading profits and losses with transaction costs for a strategy that starts on the day following the loan announcement day (Strategy B)

Trading Profits with transaction costs		Strategy leg: Short position		Strategy leg: Long position		Strategy: Long and Short, *[+1, +10]*	
		Profits ($)	% of profitable trades	Profits ($)	% of profitable trades	Profits ($)	% of profitable trades
Pooled:	Sum	-10,070.43	50.10% of 2,541 trades	39,048.71	48.41% of 2,541 trades	28,978.28	48.96% of 2,541 trades
	Min	-2,113.33		-951.12		-1,471.51	
	Max	895.85		2,782.39		3,242.44	
	Mean	-3.96		15.37***		11.40***	
	t-stat	(-1.16)		(3.47)		(2.45)	
	Median	0.31		-2.47		-1.48	
	z-val	[0.40]		[-0.49]		[-0.31]	