Call Me Maybe:
Corporate Bond Prices Upon Missed Call Opportunities

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Abstract

In a sample of discretely callable corporate bonds, we find excess returns of approximately 40 b.p. realized on the release of the issuer's decision to call or not to call. The bonds that should have been called (in-the-money bonds) but are not called contribute the most to the bond price jump. We attribute the jump to the revaluation of an embedded bond call option due to a missed exercise opportunity. Investors sell callable bonds prior to the release of the issuer's decision and later buy back not-called, in-the-money bonds, leaving the price jump in bond dealers' pockets.

Keywords: callable bonds, call dates, option, exercise, moneyness, trading volume

JEL Classification: G12

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Introduction

Bonds with fixed coupon payments appear to be straightforward financial instruments. Discounting a stream of known cashflows, one obtains the bond price. However, in practice, most corporate bonds contain embedded options that contribute to the bond's value. Our paper studies how the price of a bond that the issuer can call before its maturity date (a callable bond) changes as the issuer publicly releases the decision to call or not to call. Given that approximately two-thirds of secondary market transactions involving U.S. corporate bonds in the last twenty years were made with callable bonds, a better understanding of callable bond pricing is thus of major importance for investors, dealers, and market regulators.

This paper studies callable bond prices around dates when uncertainty about the nearest call decisions is resolved. A subset of callable corporate bonds, known as 'retail notes', has discrete call schedules predetermined at the time of bond issuance. If the issuer calls the bond, it must notify the bondholders about the call, typically no later than thirty days prior to a set call date. If the issuer does not call the bond at the nearest call date, there is no call notice at the thirty-day deadline.[1] In either case, there is no uncertainty about the nearest call decision left after the notice deadline, which is a calendar date known since issuance.

We run an event study on callable bond prices around such exogenous notice deadlines. We find large and positive bond returns realized upon the passage of the deadline dates. The average bond price appreciation in the event window amounts to 95 b.p. We attribute more than half of the effect to within-event changes in the economy's general level of interest rates. The remaining part, approximately 40 b.p., is the excess event return. van Binsbergen, Nozawa, and Schwert (2023) find that, on average, only 5 to 10 b.p. of monthly corporate bond returns are unexplained by changes in the general level of interest rates. We find that around possible bond call notice dates, this unexplained component is several times larger. Our paper studies why that is the case and claims that the excess event return is primarily due to the re-valuation of the embedded bond call option. More specifically, we argue that

[1] However, the issuer still has the right to call the bond at one of the later call dates. The embedded call option is thus of the Bermudan kind.

issuers do not call the bonds as often as they should be profitably calling, thus destroying part of the option value, which translates into higher bond prices for investors.[2]

Bonds differ in the likelihood of an early call. If the issuers can retire an existing bond and replace it with a new one at a lower cost, they have a clear incentive to do so. Denote as 'in-the-money' (ITM) such callable bonds that can be profitably retired and replaced. Similarly, out-of-the-money (OTM) bonds are those that cannot be refinanced at better terms. The arrival of a call notice for an ITM bond should be less surprising to investors than no such notice. Analogously, the call of an OTM bond is more of a surprise than an OTM no-call. Do we observe higher notice returns when there is a surprising resolution of call uncertainty? Yes, we do for ITM no-calls.

We built a practical measure of call option moneyness that does not depend on the callable bond price and uses the prices of similar non-callable bonds instead. We demonstrate that option moneyness is the strongest and the most robust factor of call decisions in our sample of bonds: the higher the moneyness, the more likely the call is. Significant offsetting factors are financial constraints (highly leveraged, less profitable firms call less frequently) and debt maturity (long-maturity bonds are less likely to be called, yet there is no evidence of successful call timing in the data). Yet, even after controlling for such offsetting call factors, the moneyness-implied call frequency remains low. More than 60% of profitable call opportunities do not lead to a call. Do missed calls represent suboptimal exercise decisions by bond issuers? Partly, they do. In line with such interpretation, call probability rises considerably at the firms' fiscal year ends, suggesting that the lack of attention might drive missed calls at other times.

ITM no-calls are the main driver of excess bond returns around call notice deadlines. Excess returns are at least 25 b.p. higher for not-called ITM bonds than for called ITM bonds. We argue that this difference represents a re-valuation of the embedded bond call option following a no-call. One would expect such a revaluation if investors treat ITM no-calls as surprising (no-)exercise decisions. Such a surprise component of excess ITM returns extends to 100 b.p. once confounding event return factors are accounted for. In a subset of

[2]Even though the result is obtained in the sample of retail notes, we show in Section 4 that similar effects are also observed in the core institutional-sized bond market.

the main sample where we observe both callable and non-callable bonds of the same issuer, we show that the ITM no-call return is specific to the callable bonds. We also calibrate a classic parsimonious single-factor option pricing model to demonstrate that, in the model, one obtains a missed-call bond price jump in line with what we observe in the data.

Bondholders benefit from such price appreciation of callable bonds around notice dates. Yet, it turns out that in the weeks preceding scheduled call notice days, the investors are net sellers of callable bonds (all of them, not only ITM). Therefore, the dealers' callable bond inventory increases pre-notice. Following the absence of a call notice, investors buy the bonds back but at higher prices – and the dealers pocket the difference. We show that the market impact of such investor flows explains only a small fraction of excess event returns. The exposure of a callable bond portfolio to the liquidity risk factor does not attenuate the abnormal portfolio return either. Hence, a liquidity provider in callable bonds ahead of notice deadlines enjoys a return above and beyond compensation for known risk factors.

By identifying jumps in callable bond prices around (no-)call notice dates, our paper contributes to the literature that studies the value of embedded bond call options. King (2002) evaluates embedded option values by constructing non-callable bond portfolios matching traded callable bonds in coupon rates and maturity and shows that the bond call option is, on average, worthless up to one year before the first possible call date. The firms that call aggressively have a higher option premium. Becker, Campello, Thell, and Yan (2024), in the first part of their paper, evaluate bond call option premia on a more recent sample to find an average premium of approximately 2-2.5%, which is close to King (2002). Our paper extends these results by showing how the call premium jumps upon the passage of call notice deadline dates, which are known already at the time of bond issuance.

Our results on embedded option moneyness and bond call likelihood link the paper to the literature on why and how bond issuers call their bonds. Mauer (1993) shows that, because of transaction costs, it may not be optimal for a firm to call a bond as soon as the embedded call option is in the money. We find a lack of calls even among deep-in-the-money bonds. King and Mauer (2014) investigate the delay between when it becomes optimal to call and when the bond is called. Such a delay, which is a suboptimal no-exercise leading to a price jump in our study, is more likely under higher refinancing costs, higher interest rate volatility, a steeper term structure of interest rates, and less liquidity on the issuer's balance sheet. We demonstrate that there are still too few bond calls for high levels of moneyness even when macro-, issuer-, and issue-specific call factors are accounted for. Beaumont, Schumacher, and Weitzner (2023) suggest a novel explanation for why bond calls are delayed: it might be because the issuers value the relationship with large institutional investors who would be subscribing to new bonds of the issuer, thus lowering the cost of capital for the firm. Bond calls result in losses for investors and damage the relationship. Chen, Cohen, and Liu (2022) show that municipal bond calls are also delayed. In that paper, the delay is primarily due to a lack of issuer attention. Our paper contributes by showing that the effect of delayed option exercise on the bond price depends on option moneyness and that bond investors are pricing delayed in-the-money exercises as a value transfer from the issuer to the bondholder.

One can also view the issuer's cost of not exercising an embedded bond call option as insufficient to outweigh a publicly unobserved issuer's benefit from having callable debt on the balance sheet. This links our work to a broader literature on why firms issue callable debt in the first place. Crabbe and Helwege (1994) examine multiple agency-theoretical reasons for why firms issue callable bonds but find little supporting evidence for either. More recently, Chen, Mao, and Wang (2010) argue that firms might issue callable bonds when management believes that future investment risks are high. They empirically confirm their theoretical assumptions. Becker *et al.* (2024) and Flor, Petersen, and Schandlbauer (2023) both link the issuance of callable bonds to the debt overhang problem but disagree on whether callable debt alleviates or exacerbates the problem. Finally, Ma, Streitz, and Tourre (2023) develop an elegant model to distinguish the role played by interest rate risk and rollover risk in the decision to issue callable versus non-callable bonds. They apply the model to high-yield callable bonds to find supporting evidence for callable debt being used as an instrument to manage rollover risk. Most of the above literature links callable debt issuance and management to agency conflicts within a firm. Our paper shows that the marginal investor in callable bonds likely has a simpler view of the world: a deep-in-the-money callable bond should be called, and if it is not, the prices adjust accordingly, even if the issuer keeps receiving agency benefits of callable debt.

Our study also sheds light on the risks associated with investments in retail notes, a popular security among high net-worth individuals and family offices. In 2019, the Fixed Income Market Structure Advisory Committee (FIMSAC) established by the SEC called to *'...educate retail investors on the uses, characteristics, and risks of retail notes. The initiative should identify the embedded issuer call option and survivor put options that are typical in these notes along with other options that may have an impact on the pricing of these notes.'* U.S. SEC (2019). Our paper addresses this call. We further show that the underlying mechanisms behind callable bond price jump around notice deadline dates remain valid in the institutional bond market, too.

The paper is organized as follows. Section 1 discusses the sample, establishes the timeline of events preceding possible bond calls, defines event returns and bond moneyness, and describes the cross-section of event returns. Section 2 studies bond moneyness and its relationship with call probability and links moneyness, (no-)calls, and event returns – both in the data and in a calibrated option pricing model. Section 3 elaborates on the trading volume patterns in the event window and discusses the implications for callable bond portfolio investments. Section 4 finds comparable effects in bond samples beyond retail notes and thus validates the main results of the study. Section 5 concludes the paper.

1 Sample, notice events, and notice returns

1.1 Sample

The majority of corporate bonds traded in the U.S. are callable. In TRACE (the dataset of all corporate bond transactions administered by FINRA), approximately 70% of transactions are with callable bonds (also referred to as 'callables' below). The callable bond issuer has the right but not the obligation to call the bond before maturity. The terms of such a call vary across bonds. The key characteristics of the call feature are when (how often) and at what price the bond can be called.

With respect to the call price, there exist two broad categories of callables. The first category of bonds pays back the discounted sum of all remaining cash flows. The spread to the Treasury curve used to determine the discount rates is typically fixed at the time of bond issuance. Such bonds are called 'make-whole' callable bonds, and they comprise approximately 75% of the callable TRACE subset. Bonds of the second category, when called, pay back a fixed price. Such a call price (or a schedule of call prices) is also fixed at issuance. These bonds, which we call 'non-make-whole' of 'fixed-price' callables, constitute a smaller fraction of callable TRACE bonds. Make-whole and fixed-price options are not mutually exclusive: a subset of make-whole callables has an embedded fixed-price option. Make-whole bonds are predominantly continuously callable, meaning they can be called at any date (possibly after an initial protection period of several years). Conversely, most non-make-whole bonds are only callable at fixed dates predetermined at issuance. The discreteness of possible call dates is particularly useful for analyzing the uncertainty of the resolution of call decisions. Thus, in this paper, our sample consists of non-make-whole, discretely callable bonds. It accounts for approximately 20% of all callable bonds in TRACE.[3]

Almost all non-make-whole, discretely callable corporate bonds in TRACE are of one of the two specific types called 'retail notes' and 'corporate medium-term notes' (they represent together about 13% of US corporate bond issuance by outstanding amount). These are debt securities that, at the initial offering, can be purchased directly from the issuer and in smaller lots than in a typical institutional-sized bond offering.[4] Such notes are issued predominantly by large public firms because of the SEC requirements imposed on the issuers of securities sold directly to the public. In the secondary corporate bond market, the notes trade in the same dealer-intermediated over-the-counter (OTC) market as institutional bonds.

Retail notes and corporate medium-term notes differ in trading frequency (the retail ones trade more) and in the calendar characteristics of the call notice. To preserve the homogeneity of our sample and the structure of the event study, we focus on retail notes in the main analysis of the paper. Our sample in Sections 1, 2, and 3 consists exclusively of retail notes.

[3]Some elements of our analysis also apply to make-whole callables. In particular, the calculation of the moneyness of the embedded option differs only slightly between fixed-price and make-whole callables. However, the event study methodology presented in Section 1.2 does not straightforwardly extend to make-whole continuously callable bonds. We show in Section 4 that the economic mechanisms discussed in the paper extend, nonetheless, beyond the main sample of the paper.

[4]Brokers act as sales agents for the issuers at initial retail and corporate medium-term note offerings. Unlike in the traditional underwriting process, brokers receive commissions but do not hold notes in their inventory.

A smaller sample of corporate medium-term notes is discussed in Section 4, establishing our results' external validity. Likewise, in that section, we look into core institutional-sized bonds that are continuously callable but their fixed-price call option resets at pre-determined dates to pre-determined call prices. As is common in the corporate bond literature, we only retain fixed-coupon, USD-denominated, not asset-backed, and non-convertible bonds in the samples. We clean raw TRACE data as in Dick-Nielsen (2014).

An important feature of a call option embedded in retail notes is that, at issuance, it has multiple possible exercise dates; in other words, the call option is Bermudan. If the issuer does not call the bond at the nearest call date, she can still call the bond at one of the later exercise dates (unless it is the last of the scheduled exercise opportunities). If the intervals between scheduled call dates were zero, a Bermudan option would be identical to an American option. In our sample, the majority of bonds are callable semi-annually. We also have a few bonds callable quarterly or annually. We remove from the sample a handful of bonds callable at a monthly (or shorter) frequency to preserve the interpretability of our event study, which we now describe.

1.2 Event timeline

All bonds in our sample have a calendar of possible call dates and call prices, which are known at issuance. If the issuer decides to call the bond, she must issue a call notice at least 30 days prior to the scheduled call date.[5] Therefore, either a release of the call notice or a passage of the 30-day notice deadline (without notice being released) resolves the uncertainty about the nearest possible call. Assuming that bond issuers do not release call notices earlier than a week before the notice deadlines,[6] we define a period of 7 calendar days prior to (and including) the notice deadline as the instance when the new information about the value of the embedded call option becomes public. This is an information event around which we conduct an event study.

[5]Alternative call notice periods, longer or shorter than 30 calendar days, are possible, but that does not occur in our sample. The call notice period, as registered in the prospectus, is available in the Mergent FISD dataset, which we use for bond characteristics.

[6]There is no dataset with a historical record of call notice release dates. We manually checked the release dates in a few recent bond calls on Bloomberg and did not find any evidence of call notice releases earlier than 7 days prior to the deadlines.

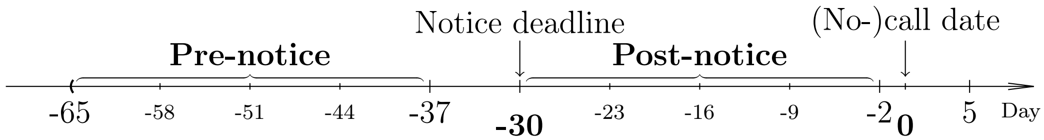

Figure 1: Event timeline in calendar days. Day 0 is the possible bond call date. It is known at the time when the bond is issued. Day -30 is the deadline for a call notice. We define 'pre-notice' period as 28 calendar days ending one week before the latest possible call notice, corresponding to days between 64 and 37 on the event timeline (inclusive). 'Post-notice' period is another 28 calendar days between -29 and -2 on the event timeline.

Figure 1 presents the timeline of the event study. Our main focus is the comparison of post- to pre-notice bond prices. We define the pre-notice period as 28 calendar days ending 7 days before the scheduled call notice deadline. The post-notice period is 28 calendar days following the notice deadline. In the post-notice period, it is publicly known whether the bond will be called at the nearest call date (which is date 0 in Figure 1). In the pre-notice period, such information is not publicly available. The difference between pre- and post-notice bond prices is the event return, which is the main focus of this paper.

As previously mentioned, we exclude from consideration bonds that are callable monthly: for such bonds, event periods overlap, which creates a mechanical dependence between notice returns in the cross-section of bond events. Therefore, the set of notice events consists of non-overlapping bond-event observations.

1.3 Return measurement

We define total bond return, R_i, around a (no-)call notice event i as

$$R_i = \frac{\bar{P}_i^{\text{post}} - \bar{P}_i^{\text{pre}}}{\bar{P}_i^{\text{pre}}},$$

where $\bar{P}_i^{\text{pre}}$ and $\bar{P}_i^{\text{post}}$ are simple averages of volume-weighted daily invoice prices in the pre- and post-notice periods, respectively, as defined in Figure 1.[7] We observe $\bar{P}_i^{\text{pre}}$ and $\bar{P}_i^{\text{post}}$ if there is at least one TRACE-reported transaction in the respective period. In our sample,

[7]The invoice price is the 'dirty' price of the bond: it is the sum of the transaction price and the accrued interest. This is the price a buyer needs to pay to acquire a bond.

there are no bonds that pay coupons in a 90-day period prior to the nearest call date (date 0 in Figure 1); hence, R_i represents a total return to an investor buying at $\bar{P}_i^{\text{pre}}$ and selling at $\bar{P}_i^{\text{post}}$.

Following Gilchrist and Zakrajšek (2012) and van Binsbergen *et al.* (2023) in bond return measurement, we distinguish corporate bond returns that are due to the changes in the term structure of risk-free rates and those that are due to changes in yield spreads. We define the spread component of the notice return or, simply, the 'excess return' XR_i as

$$XR_i = R_i - RF_i,$$

where RF_i is the total event return on a synthetic risk-free bond $\mathcal{B}_i$:

$$RF_i = \frac{\bar{P}_i^{\mathcal{B},\text{post}} - \bar{P}_i^{\mathcal{B},\text{pre}}}{\bar{P}_i^{\mathcal{B},\text{pre}}}.$$

Bond $\mathcal{B}_i$ has the exact same size and schedule of coupons and principal repayments as the bond under consideration in event i, but its daily price is calculated as the sum of scheduled cash flows discounted at the Treasury yield curve. We retrieve the history of Treasury yield curves estimated as in Gürkaynak *et al.* (2007) from the Federal Reserve website. For the purpose of this paper, XR_i is a better measure of event returns than R_i because it captures bond returns beyond a macroeconomic-driven revaluation.

In some empirical tests in the latter parts of the paper, we also use the excess return above a narrow non-callable benchmark, XRS_i^n, which we measure as

$$XRS_i^n = XR_i - XR_i^n,$$

where XR_i^n is the excess return of a duration-matched[8] non-callable bond of the same issuer in event i. This narrow benchmark is only available for approximately half of the events in our sample. For econometric reasons, we also consider duration-scaled bond returns in several empirical tests in this paper. These are event returns XR_i divided by bond duration

[8]Both the callable and the non-callable bond of the same issuer must be in the same decile of the cross-sectional duration distribution.

D_i. We denote such duration-scaled bond return xr_i. We present all of the paper's results first and foremost in terms of the excess return XR_i and use alternative return measures to highlight additional economic or econometric aspects of our argument.

1.4 Embedded option moneyness

Callable bonds differ in the moneyness of embedded call options. Consider a bond callable at the par value of 100. Imagine that an otherwise identical non-callable bond of the same issuer trades simultaneously at the price of 103, and there is sufficient demand for new offerings at this price. In a frictionless world, a bond issuer can call the bond at 100 and issue a non-callable bond, raising 103 instead of 100 and realizing a gain of 3%. The call price of 100 is a strike price, and the difference between the price of the non-callable bond and the strike can be interpreted as the intrinsic value of the call option embedded in the callable bond. In the example above, the intrinsic value is positive, and the embedded call option is in-the-money (ITM).

We measure the moneyness for each callable bond in our sample, as in the example above, by comparing its price with the price of an otherwise identical non-callable bond. Generally, the latter does not exist in practice, so we construct a synthetic non-callable bond by discounting the promised cash flows of a callable bond at a benchmark non-callable yield. We calculate such benchmark yield $\bar{y}_i^b$ as the size-weighted average yield of a basket of rating-coupon-maturity-matched non-callable bonds:

$$\bar{y}_i^b = \sum_j \omega_{i,j} \bar{y}_{i,j}^b, \tag{1}$$

where $\bar{y}_{i,j}^b$ is the average pre-notice yield-to-maturity of bond j included in the broad benchmark portfolio in event i, and $\omega_{i,j}$ is the ratio of bond j outstanding amount to the sum of outstanding amounts of all benchmark portfolio bonds. Bond j is included in the benchmark portfolio if:

– it is a non-callable TRACE-reported corporate bond;

– it has the same credit rating as the callable bond under consideration (matching is on letter ratings here, AAA, AA, etc., with the three bottom non-default categories, CCC to C, merged into one);

– it belongs to the same maturity bin as the callable bond, with maturity bins (7 in total) exogenously defined by breakpoints 1Y, 3Y, 5Y, 7Y, 10Y, 15Y, and 30Y;

– it belongs to the same coupon-rate bin as the callable bond, with coupon bins (8 in total) exogenously defined by breakpoints 2%, 3%, . . . , 8%, 10%.[9]

Such a matching procedure yields a benchmark basket of at least ten non-callable bonds for each callable bond event.

Now, consider a (no-)call notice event i, and denote by $\{CF_{i,\tau}\}$ the set of promised cash flows of the callable bond (up until maturity and including the principal repayment) with τ being the payment times. An observed yield of the matched non-callable bond portfolio is $\bar{y}_i^b$, which is defined in (1). Then, the price of the synthetic non-callable bond of interest is

$$P_i^{NC}\left(\bar{y}_i^b\right) = \sum_{\tau} e^{-\tau \bar{y}_i^b} CF_{i,\tau}.$$

This is the amount of money the issuer can raise by issuing, at the yield of $\bar{y}_i^b$, a non-callable bond with the same promised cash flows as the callable bond. Denote a known call price at the nearest call date P_i^{call}. Then, pre-notice, the intrinsic value of the call option embedded in such a callable bond is:

$$\bar{IV}_i^{\text{pre}} = \frac{P_i^{NC}\left(\bar{y}_i^b\right) - P_i^{\text{call}}}{P_i^{\text{call}}} \times 100\%, \tag{2}$$

measured in percentages of the call price.[10] Note that $\bar{IV}_i^{\text{pre}}$ *does not depend* on the callable bond yield and only includes the information about the callable bond that is known at its issuance: the coupon structure, maturity, call dates, and call prices. If $\bar{y}_i^b$ does not change,

[9] In unreported results, we also performed duration-matching to a broad bond portfolio that delivers quantitatively and qualitatively similar results on event returns. We prefer matching on coupon, rating, and maturity because it delivers the benchmark yield (1) that is a better measure of the cost of borrowing, in our opinion.

[10] Ma *et al.* (2023) consider a similar measure of moneyness that uses CDS spreads instead of non-callable yields to proxy for the cost of non-callable borrowing.

neither does the intrinsic value of the callable bond, even if the yield of the callable bond fluctuates.[11]

In principle, an intrinsic value above 0% means that the embedded option is in the money, and the issuer would benefit from calling it. However, there is a cost of calling an issue and placing a new non-callable bond instead. This cost is difficult to estimate for individual bonds. Altinkihc and Hansen (2000) estimate the average debt underwriting cost to be approximately 0.5–1.5% (depending on the borrower's credit quality), though it is probably lower for retail notes due to a simpler issuance procedure. There is also possibly an estimation error in the intrinsic value (2). For these reasons, we call ITM embedded options that have a pre-event intrinsic value $\bar{IV}_i^{\text{pre}}$ above 4%. We call the bonds with $\bar{IV}_i^{\text{pre}} \in [0\%; 4\%]$ 'at-the-money' (ATM). Bonds with an intrinsic value of the option below 0% are OTM. The choice of the 4% moneyness threshold does not drive the paper's results: we obtain similar results (unreported) with several percentage points higher or lower thresholds. An added benefit of this choice of a rather conservative threshold is that it balances the size of OTM-ATM-ITM bins well.

1.5 Summary statistics

Table 1 summarizes the sample. We observe more than 13,000 bond-events spread across the years 2002–2023.[12] A representative event is a no-call notice of a 5.5%-coupon bond that matures in approximately nine years and was issued five years ago. It is a BBB(+)-rated bond traded at a yield spread of 7% with 7.5 years duration. The average outstanding amount of the bond is close to \$17m.[13]. The bond is OTM and is likely not called in the sample period (13% of the events in the sample are call notices – the rest are no-calls). Most bonds in the sample are issued by large and profitable public firms (with \$90 bn market

[11] Callable bond yields and hence prices change with the perceived call risk, which makes them a poor indicator of the bond's moneyness. Intuitively, a bond that is likely to be called must be priced as a short-term, not a long-term, bond. In many cases, that means being traded close to the call price (assume par), but how close depends on multiple factors (steepness of the term structure, call probability, and bond maturity, for example). A bond traded at 99 does not need to be OTM. Likewise, a bond traded at 101 is not necessarily ATM/ITM.

[12] The sample of (no-)call events is not evenly spread across years from 2002 to 2023. Figure A1 in the Appendix shows fewer callable retail notes outstanding in more recent sample years.

[13] The external validity Section 4 looks into samples of bonds with outstanding amounts of approximately \$100mn and \$500mn per bond.

capitalization and 6% profit margin, on average). Table A1 in the Appendix lists the top issuers in our sample; large industrial and financial corporations dominate in the list.

Panel (B) of Table 1 demonstrates how callable bonds differ from benchmark non-callable bond portfolios. The average difference between the callable bond and the matched non-callable portfolio in maturity, age, and duration is less than eight months. The coupon rate only differs by eight b.p., on average. Benchmark portfolios consist of bonds with much larger outstanding amounts (they are, primarily, institutional-sized bond issues).[14] The average difference in the yield spread between the callable bond and the matched non-callable bond portfolio is approximately 110 b.p. Remarkably, approximately 15% of sampled callable bonds have lower yields than matched non-callable bonds pre-notice. One can interpret this as a negative value of the embedded call option. The proportion of negative-value call options in our sample is then similar to that reported in King (2002). Mind, however, that our measure of call option moneyness (2) is *not* the difference in observed callable and non-callable yields and does not depend on the yield of a callable bond itself.

Panel (D) of Table 1 lists several trading activity characteristics of sample callable bonds. The average dealer-to-client trading volume per *calendar* business day is approximately 9 b.p. of the outstanding amount, which translates to a total of 1.8% of the outstanding amount traded in the pre-notice period. This volume is relatively balanced. The median net volume (client purchases from dealers in excess of client sales to dealers) is zero, and the mean is slightly (but significantly) negative at -0.19 b.p. of the outstanding amount (per trading day). This indicates that the total dealer inventory of retail notes increases pre-notice. The bonds in our sample only trade, on average, three out of ten business days, which is similar to other bonds in TRACE (Dick-Nielsen *et al.* 2012 report a TRACE average of zero-trading days of 60%; in the Harris (2015) sample, it is closer to 70%).

[14] Bonds with larger outstanding amounts tend to be more liquid (Bao *et al.*, 2011), which translates into higher returns (Dickerson *et al.*, 2023a). We discuss in Section 3.2 that exposure to liquidity risk does not explain callable bond notice returns.

	Mean	S.D.	5th	25th	Med.	75th	95th	N.Obs.
(A) Callable bonds characteristics								
Maturity, years	9.25	5.76	1.67	4.71	8.26	12.31	20.43	13464
Size, $ mn	16.73	19.77	2.47	5.58	10.19	20.55	50.00	13464
Age, years	4.81	2.43	1.35	2.89	4.90	6.46	8.99	13464
Coupon rate, %	5.49	1.09	3.25	5.00	5.50	6.15	7.05	13464
Rating	8.18	4.26	3.00	5.00	8.00	10.00	16.00	13464
Duration, years	7.42	4.03	1.63	4.27	6.91	9.57	14.88	13464
Yield spread, %	7.22	5.07	3.53	5.35	5.95	7.16	13.87	13464
Money-ness, %	-3.14	12.01	-25.46	-6.72	-1.16	3.41	11.24	13464
Called (dummy)	0.13	0.34	0.00	0.00	0.00	0.00	1.00	13464
(B) Difference to duration- and rating-matched portfoio								
ΔMaturity, years	-0.59	2.51	-5.86	-0.88	-0.01	0.62	1.85	13464
ΔSize, $ mn	-1052	912	-2956	-1502	-794	-375	-32	13464
ΔAge, years	0.05	3.83	-6.77	-1.83	0.33	2.71	5.45	13464
ΔCoupon rate, %	-0.08	0.33	-0.61	-0.33	-0.09	0.17	0.45	13464
ΔDuration, years	-0.34	1.60	-3.74	-0.69	-0.00	0.49	1.38	13464
ΔYield spread, %	1.10	2.99	-1.17	0.22	0.67	1.50	4.31	13464
(C) Issuer characteristics								
Market cap., $ bn	86.61	84.14	2.79	23.56	52.50	145.62	218.41	11167
Book leverage, %	42.73	21.45	5.84	29.25	41.94	61.77	70.63	11167
Profit margin, %	6.15	11.29	-10.03	1.11	6.48	10.00	19.88	11167
Equity return, %	0.37	12.83	-18.14	-5.50	0.54	5.81	18.40	11179
(D) Trading characteristics								
Daily vlm, b.p. of size	9.16	19.08	1.00	2.81	5.24	9.58	26.60	13464
Net volume, b.p. of size	-0.19	3.41	-4.02	-0.70	0.00	0.32	3.43	13464
No-trading days, %	71.00	20.74	26.32	60.00	78.95	85.00	94.74	13464

Table 1: Summary statistics

The unit observation is a bond-event. All variables are pre-notice averages except for the call dummy. The definition of the pre-notice period is in Figure 1. In Panel (A), maturity is years remaining to bond maturity. Size is the amount outstanding. Age is the time since issuance. The coupon rate is per annum. Rating is on a conventional numerical scale (1 is AAA, 2 is AA+, ..., 21 is C). Duration is the cash-flow-weighted average of scheduled payment times. The yield spread is relative to a synthetic risk-free bond with the same cash flows but discounted at Treasury rates. Moneyness is a theoretical gain to the issuer from calling a bond and replacing it with an otherwise identical non-callable bond (the details are in Section 1.4). Panel (B) presents the difference between callable and coupon-, maturity- and rating-matched non-callable bonds. In Panel (C), issuer characteristics are from CRSP/Compustat. Book leverage is the ratio of current and long-term liabilities to total assets. Profit margin is net income divided by sales. Equity return is the percentage change in the average price of the common stock post-notice to pre-notice. Table A1 in the Appendix lists the top issuers in the sample. In Panel (D), the trading activity is dealer-to-client only (inter-dealer trades are excluded). The average daily volume is per *calendar* business day (i.e., including no-trading days) and is measured in basis points of the outstanding amount. Net volume is client purchases from dealers in excess of client sales to dealers, per calendar business day. No-trading days are the days with no dealer-to-client volume. The sample period is 2002–2023.

1.6 Bond returns around (no-)call notice dates

Next, we investigate the pricing of callable bonds around notice deadlines. Table 2 presents average event returns in our sample of callable bonds. The total bond return based on average transaction prices 28 days post- relative to pre-notice, R_i, is at 95 b.p., on average (62 b.p. pre-GFC and 101 b.p. post-GFC). This is some 40 b.p. higher than the average monthly bond return in a broad basket of bonds in a comparable sample period (Dickerson *et al.* 2023a).

	R	XR	r	xr
Full sample	0.95***	0.36***	0.21***	0.12***
	(0.06)	(0.07)	(0.01)	(0.01)
Pre-GFC	0.62***	0.11	0.11***	0.02
	(0.14)	(0.15)	(0.03)	(0.03)
GFC (2008/09)	1.07***	0.49***	0.29***	0.19***
	(0.13)	(0.14)	(0.03)	(0.03)
Post-GFC	1.01***	0.40***	0.21***	0.13***
	(0.08)	(0.09)	(0.02)	(0.02)
Note:	*p<0.1; **p<0.05; ***p<0.01			

Table 2: Average notice returns
The top line is for the entire sample between 2002 and 2023. The bottom lines separate pre-GFC (2002–2007), GFC (2008–2009), and post-GFC (2010 onwards) subsamples. These estimates come from the regression model $Y_i = \beta_{\text{pre}}\mathbf{1}_i^{\text{pre-GFC}} + \beta_{\text{gfc}}\mathbf{1}_i^{\text{GFC}} + \beta_{\text{post}}\mathbf{1}_i^{\text{post-GFC}} + \epsilon_i$, where Y is one of the notice return measures, $\mathbf{1}^{\cdot}$ is the dummy variable that takes the value of 1 in the respective period. R and XR are the notice return and excess return, respectively. r and xr are the same return measures scaled by bond duration. The standard errors (in parentheses) are OLS.

Total bond returns include both the accrued interest and the price appreciation. The latter can be driven by changes in the economy-wide term structure of risk-free interest rates and a bond-specific term structure of yield spreads. The excess return metric that singles out the spread component of return, XR_i, stands at a lower average level of 36 b.p. (11 b.p. pre-GFC and 40 b.p. post-GFC), which is statistically significant. To put this number into perspective, van Binsbergen *et al.* (2023) find that a similarly calculated average spread return of a broad basket of BBB-rated bonds stands at 5 b.p. in a sample that starts in the mid-1980s and extends to the present. The excess return of approximately 40 b.p. around scheduled call notice dates is a novel empirical fact. The remainder of the paper explains this seemingly large and puzzling number.

2 Intrinsic call option value and callable bond return

In this section, we will link the documented event return to a revaluation of an embedded bond call option while controlling for alternative return drivers. The revaluation is due to the dissemination of new information about the call option exercise probability at the notice date. In the pre-notice period, if there is some uncertainty about the exercise decision, the nearest-call-date exercise probability is between 0 and 1. As the (no-)call notice arrives, the probability jumps to either 0 or 1.

The size of the exercise probability jump must be a factor of realized returns. Suppose the marginal investor believes exercise is unlikely, and a no-call notice arrives. In that case, the effect on the price of the embedded option is limited because the no-call is 'priced in' in the pre-notice period. On the contrary, a 'surprising' (no-)exercise decision should move the price of the embedded option. For instance, if investors expect the bond to be called at the nearest call date, but the issuer does not call, such a no-exercise decision destroys part of the embedded Bermudan option value. As the option becomes cheaper, the bond becomes more expensive. In this section, we a) characterize observed call exercise policies and identify surprising (no-)exercise decisions in the data, b) account for confounding factors in excess event returns, and c) benchmark the observed excess return on simulated option price changes following delayed call exercise decisions in a parsimonious option-pricing model.

2.1 Option moneyness and (no-)call decisions

We proxy for the likelihood of embedded option exercise with the intrinsic value of the embedded option as defined in (2). Recall that the intrinsic value here is a hypothetical benefit of the bond issuer from calling an outstanding callable bond and instead issuing an identical non-callable bond with a yield of a similar non-callable bond pre-notice. A negative intrinsic value means that it is unprofitable for the issuer to call the bond, the embedded option is OTM, and the exercise probability is small. As the intrinsic value increases, the call option becomes more ITM, and the exercise probability increases. In what follows, we distinguish between bonds with a small positive intrinsic value (between 0 and 4%, ATM) and a large positive intrinsic value (above 4%, ITM). The ex-ante exercise probability for the ITM bonds should be greater, on average, than for the ATM bonds – and both must be greater than the call probability of the OTM bonds.[15]

	Full sample			Post-GFC		
	OTM	ATM	ITM	OTM	ATM	ITM
No. bond-events	7698	2726	3040	3053	2208	2621
no. no-calls	7285	2231	2189	2811	1808	1956
no. calls	413	495	851	242	400	665
% called	5.4	18.2	28.0	7.9	18.1	25.4

Table 3: Bond calls by the moneyness of the embedded option
The full sample is from 2002 to 2023. The 'Post-GFC' sample is 2010–2023. 'OTM' stands for 'out-of-the-money' and includes bonds with a pre-notice average intrinsic value of the embedded call option, $\bar{IV}_i^{\text{pre}}$, below 0% (see Section 1.4 for a full definition). 'ATM' is 'at-the-money' and consists of bonds with the $\bar{IV}_i^{\text{pre}}$ between 0% and 4%. 'ITM' is 'in-the-money' and consists of bonds with $\bar{IV}_i^{\text{pre}} > 4\%$. The first three lines are event counts: the total number of bond-events, the number of events that were bond no-calls and the number of bond calls. '% called' is the ratio of calls to the sum of calls and no-calls, in %.

Table 3 presents the split into OTM-ATM-ITM bonds and shows in-sample call frequency by moneyness bin. In the full 2002–2023 sample, approximately 57% of the bonds are OTM, with the remaining 43% split almost equally between the ATM and the ITM bonds. The fraction of OTM bonds in the post-GFC sample drops to only 39%. This is expected, given the general decrease in the level of interest rates post-crisis. Lower risk-free rates, other things being equal, lead to lower corporate borrowing costs, which increase the intrinsic value of callable bonds. As interest rates drifted to an almost zero level post-GFC, there were considerably fewer OTM bonds left in the sample. The fraction of bond-events that are bond calls (the issuer exercises the call option) increases with moneyness. In the OTM

[15]Option moneyness is often defined as the intrinsic value scaled by the volatility of the underlying asset. A relevant volatility measure here is duration-times-spread (DTS), a usual proxy for the part of the bond return volatility driven by yield spread fluctuations (Ben Dor *et al.* 2007). Intuitively, high-duration, high-yield bonds should be more volatile than short-duration bonds with narrow yield spreads. Dividing the intrinsic value by the DTS does not alter the split of the sample into OTM and non-OTM bonds (unless the spread is negative, which is never the case in our sample). The only thing that changes is the split between ATM and ITM bonds. We rerun the analysis with such DTS-adjusted moneyness labels and find little difference from the results presented in the paper (unreported).

bin, only 5.4% of events are bond calls in the full 2002–2023 sample. The fraction of called OTM bonds in the post-GFC sample grows to 7.9%. This is several times lower than the fraction of calls in the ATM category (18.2% in the full sample and 18.1% in the post-GFC sample). Expectedly, the fraction of calls is the largest in the ITM category. It is in the range between 25% and 28% across different subsamples.

Figure 2: Not-called in-the-money bonds
The line traces ITM bond-events that did not lead to a call, as a % of all ITM bond-events, per calendar year. Bond-event i is 'ITM' if $\bar{IV}_i^{\text{pre}} > 4\%$ (see Section 1.4 for a full definition).

A fraction of early calls of 28% means that more than 70% of ITM bond-events do not lead to a bond call at the nearest call date. This is a strikingly high number. Figure 2 plots its evolution year-by-year. Only a few years in the sample, the fraction of no-calls among ITM bond-events drops below 50%. Between 2014 and 2023, no-calls amount to more than 80% of the ITM bond-events (although the sample is much smaller in recent years, as Figure A1 in Appendix suggests).

Before investigating the factors behind ITM no-calls, one must establish formally that bond moneyness is a call factor in the data. We will show shortly that moneyness is indeed *the* call factor in our sample of events. Why are we observing too many ITM no-calls, then? It can be that other factors of the call exercise decision attenuate the effect of option moneyness. The are a few such candidate factors. First, even in a frictionless world, the optimality of the early exercise of a Bermudan option depends on several parameters (time to maturity, yield volatility, etc.) beyond the option's intrinsic value. It could be that the continuation value exceeds an early exercise benefit for some ITM options.[16] Second, an undertaking of a positive-NPV exercise-and-reissue decision might be affected by various corporate frictions (debt overhang, the fixed dollar cost of calling a bond issue, manager inattention, etc.). We now investigate whether the data provides empirical support for such factors of call decisions.

Table 4 presents the estimates of logit models for the call dummy in our panel of bond-events. Model (1) of Table 4 establishes a strongly statistically significant link between the intrinsic value (IV) of the embedded option and the call decision. The coefficients in column (1) imply that a zero-IV bond is called with a probability of 0.18 (18%), while a bond with an IV of 4% (which is the cutoff between OTM and ITM in our definition of the embedded option moneyness) is called with a probability of 0.25. It takes an IV of almost 35% to get to the call probability of 0.9.

Models (2)–(4) in Table 4 add bond-level controls (the collection of rating fixed effects controls for bond riskiness, hence yield spread volatility) and time fixed effects. Neither of them considerably affects the magnitude of the effect of the IV on call probability. Model (4) shows that the exercise probability for longer-maturity bonds is lower, suggesting that the issuers keep the call option alive when there are more remaining call opportunities. However, as models (10) and (12) in Table 4 suggest, an increase in the bond IV relative to the previous call date does not increase the call probability significantly. Therefore, call postponements did not lead to higher embedded call option values in our sample. Also, the magnitude of the effect of maturity on call probability in model (4) is about six times lower than that of the intrinsic value of the embedded option.[17]

[16] Note that for this to be true, typically, the issuer's yield spread must be decreasing in the future with high probability.

[17] All non-binary right-hand-side variables in these logit models are standardized to have a zero mean and a unit variance to facilitate the comparison of economic effects.

	Dependent variable: $\mathbf{P}_i$ [Called]											
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Intercept	-1.95^{***}											
	(0.03)											
Intrinsic value (IV)	1.24^{***}	1.14^{***}	1.20^{***}	1.23^{***}	1.48^{***}	1.42^{***}	1.50^{***}	1.66^{***}	1.65^{***}	1.44^{***}	1.83^{***}	1.53^{***}
	(0.04)	(0.16)	(0.15)	(0.16)	(0.22)	(0.22)	(0.19)	(0.22)	(0.24)	(0.19)	(0.26)	(0.22)
Outstanding amount				-0.05	0.03	0.04	0.02	0.12	0.13	0.08	0.05	-0.00
				(0.10)	(0.10)	(0.12)	(0.10)	(0.10)	(0.10)	(0.13)	(0.11)	(0.11)
Maturity				-0.19^{*}	-0.28^{***}	-0.16	-0.28^{**}	-0.24^{**}	-0.24^{**}	-0.45^{***}	-0.27^{*}	-0.32^{**}
				(0.11)	(0.11)	(0.10)	(0.11)	(0.10)	(0.10)	(0.16)	(0.15)	(0.15)
Equity value					-0.53	-0.50	-0.51	0.33	0.30	-0.82^{*}		
					(0.47)	(0.46)	(0.46)	(1.13)	(1.17)	(0.44)		
Book leverage					-0.42^{**}		-0.36^{**}	-1.71^{*}	-1.74^{*}	-0.38^{*}		
					(0.17)		(0.18)	(0.99)	(0.98)	(0.21)		
Market leverage						-0.50						
						(0.34)						
Profit margin							0.27	0.85^{***}	0.86^{***}	0.27		
							(0.25)	(0.30)	(0.30)	(0.36)		
Total payout ratio							-0.29	-0.32	-0.33	-0.31		
							(0.24)	(0.36)	(0.38)	(0.32)		
Equity return (notice)									-0.01	0.09		
									(0.09)	(0.08)		
Equity return (pre-notice)									-0.19	-0.28		
									(0.21)	(0.24)		
Fiscal year-end (dummy)									0.52	0.67	1.31^{**}	2.00^{***}
									(0.44)	(0.42)	(0.58)	(0.77)
IV > IV @ prev. notice (dummy)										0.34		0.08
										(0.21)		(0.20)
Year FE	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO	NO
Rating FE	NO	NO	YES	YES	YES	YES	YES	YES	YES	YES	NO	NO
Issuer FE	NO	NO	NO	NO	NO	NO	NO	YES	YES	YES	NO	NO
Issuer×Year FE	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES	YES
Num. obs.	13464	13464	13464	13464	11167	11098	10367	10367	10367	7454	10837	7862

$^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$

Table 4: Logit model for the call dummy

The dependent variable equals 1 if the bond is called in event i and is 0 otherwise. All right-hand side variables, except for the dummies, are standardized (have a zero mean and a unit variance) in the cross-section, and all refer to pre-notice averages unless explicitly specified. 'Intrinsic value' is the intrinsic value of an embedded callable bond option. 'Outstanding amount' is the bond issue size. 'Maturity' is the remaining time to bond maturity. 'Equity value' is the equity market capitalization of the bond issuer. 'Book leverage' is the sum of current and long-term debt to total assets ('market leverage' — to the firm value). 'Profit margin' is net income to sales. 'Total payout ratio' is dividends and share repurchases to net income. 'Capex ratio' is capital expenditures to total assets. 'Equity return' is the return on the issuer's common stock either in the event window (notice) or in the pre-notice period. 'IV $>$ IV @ Previous notice' is 1 if the intrinsic value increased relative to the previous notice date of the same bond and 0 otherwise. 'Fiscal year-end' is 1 if the call date falls into a month, which is the end of the firm's fiscal year. Issuer×Year fixed effects apply only to the subsample of issuers with at least 10 bond-events per year. The sample period is 2002–2023. Standard errors are clustered by issuer.

Models (5)–(10) of Table 4 further control for different issuer characteristics (size, leverage, profitability, investments, payout to shareholders, return on the issuer stock, fiscal year-end) both with and without issuer fixed effects. Here, the most robust of the issuer-specific call factors appears to be book leverage: highly leveraged firms are less likely to call the bonds. This result aligns with the debt overhang mechanism, suggesting that leverage constraints prevent firms from undertaking positive NPV projects (like calling in-the-money bonds and issuing non-callable debt at a lower cost). Consistent with such a mechanism, a higher profit margin increases call probability as the former likely relaxes the leverage or cash constraint. Other issuer-specific factors have little to no explanatory power for bond calls. In particular, there is no evidence of the return on the issuer's stock, either pre-event or within the event window, being significantly correlated with the call decision.

In models (11)-(12), we consider a subset of the event sample with at least 10 events per issuer per year, which allows us to include issuer-year fixed effects. Such fixed effects absorb the variation in call probabilities due to issuer-specific time-varying factors and help us identify call factors within the issuer and a calendar year. Here, we still find IV as a prime call probability factor, with bond maturity mildly attenuating the effect without any evidence of call postponement increasing the option money-ness. Remarkably, though, the issuers are more likely to call the bonds if the call dates coincide with the end of the fiscal year (we have about 1k of such events in our sample). The effect is not only statistically significant but also economically strong. With the loading on the call dummy between 1.3 and 2 in models 11 and 12, the fitted call probability for just in-the-money bond (IV of 4%) increases from 25% to 55-70% (it still takes an IV of above 15% to reach 90% call probability).[18] We think that the most plausible explanation behind a higher call probability at fiscal year-ends is higher attention of firm managers to the terms of the outstanding debt at the ends of accounting periods, which is particularly relevant for small-sized bond issues (like in our sample) that the managers might not pay enough attention to at other times.

Beaumont *et al.* (2023) suggest that bond call decisions are also partly driven by relationship motives between issuers and investors. If an issuer calls a bond early (even if it is

[18] A higher corporate bond call probability at fiscal year-ends is the opposite result to Chen *et al.* (2022), who find longer call delays in municipal bonds towards local governments' fiscal year-ends that are viewed as 'busy' periods exhausting cognitive abilities of financial managers.

an ex-ante optimal policy), institutional investors tend to stay away from new bond issues of that firm. If such investors are large, the lack of future demand for the firm's bonds might affect the cost of raising new debt. Trading off higher borrowing costs and costs of a delayed exercise, some issuers choose to delay the call option exercise. Unfortunately, we observe only a small fraction of reported institutional holding in our sample of retail notes. Hence, we can not credibly test whether the relationship motive is a valid factor of exercise delay in our sample. Given the small fraction of the outstanding corporate debt that the retail notes represent, one would expect the relationship channel to be less important than other factors presented in Table 4.

The key implication of the above analysis of call factors is that the moneyness of the embedded call option is the strongest and the most robust factor of call decisions, which makes the lack of calls of deep-in-the-money bonds even more remarkable. There are too few bond calls, even controlling for call factors that might attenuate the effect of option moneyness on the exercise probability. The highest loading on bond IV in Table 4 (1.83 in model 11) still implies that only a third of just in-the-money bonds would have been called. We now move on to link this lack of in-the-money bond calls to observed notice returns.

2.2 Option moneyness and notice returns

In this section, we characterize event returns conditional on bond moneyness and the (no-)call decision. We assume that the unexpected exercise decisions must generate notice returns, while the expected decisions should not move bond prices. By comparing returns within moneyness bins and between different call outcomes, we uncover which (no-)call decisions investors are pricing as surprises. We are finding that ITM no-calls are indeed priced as surprises, consistently with the value transfer from issuers to investors at the time of a delayed option exercise.

For illustrative purposes, we characterize first average event returns associated with different call outcomes conditional on option moneyness (a full model with the surprise price component and confounding factors follows later in the section). For this, we regress, in a cross-section of events, the excess return on respective dummy variables:

$$XR_i = \beta_1 \mathbf{1}_i^{\text{OTM}} \times \mathbf{1}_i^{\text{Not called}} + \cdots + \beta_6 \mathbf{1}_i^{\text{ITM}} \times \mathbf{1}_i^{\text{Called}} + \epsilon_i. \tag{3}$$

The estimated coefficients $\hat{\beta}_1, \ldots, \hat{\beta}_6$ are average excess event returns conditional on moneyness and call decision.

	Dependent variable: XR		
	Full sample	Ex-GFC	Post-GFC
ITM × Not-called	0.48**	0.50**	0.59***
	(0.19)	(0.19)	(0.16)
ITM × Called	0.23*	0.23*	0.06
	(0.13)	(0.13)	(0.14)
ATM × Not-called	0.05	0.06	0.07
	(0.16)	(0.18)	(0.20)
ATM × Called	0.06	0.03	−0.16
	(0.20)	(0.22)	(0.19)
OTM × Not-called	0.40***	0.38	0.63**
	(0.14)	(0.24)	(0.30)
OTM × Called	1.21***	0.77***	0.54**
	(0.36)	(0.28)	(0.20)
Observations	13,452	10,588	7,870
Note:	*p<0.1; **p<0.05; ***p<0.01		

Table 5: Average notice return by option moneyness and call decision
The regression model is $XR_i = \beta_1 \mathbf{1}_i^{\text{ITM}} \times \mathbf{1}_i^{\text{Not-called}} + \cdots + \beta_6 \mathbf{1}_i^{\text{OTM}} \times \mathbf{1}_i^{\text{Called}} + \epsilon_i$, where $\mathbf{1}^{\mathcal{M}}$ is the dummy that takes the value of 1 if condition $\mathcal{M}$ is satisfied and 0 otherwise. Hence, β_j is a conditional average notice spread return (in %). The 'Ex-GFC' sample excludes the years 2008 and 2009 from consideration. The 'Post-GFC' sample is from 2010 to 2023. The number of observations behind each estimated coefficient is in Table A2 in the Appendix. The standard errors are clustered at the issuer level.

Table 5 presents the estimates from model (3) in the full 2002-2023 sample and in subsamples excluding the GFC episode. We find that in the 2002–2023 sample, significantly positive event returns are generated by ITM and OTM bonds, with ITM no-calls (48 b.p.) and OTM calls (121 b.p.) having the strongest return magnitude. Excluding years 2008 and 2009 from the sample renders the OTM return effects smaller and less statistically significant. Further zooming into post-GFC years, the return on OTM calls reduces to 63 b.p. and is not much different from the average OTM-no-call return (54 b.p.). Conversely, the

ITM-no-call excess return strengthens post-GFC and stands at 59 b.p., while an ITM-call return is statistically indistinguishable from zero.

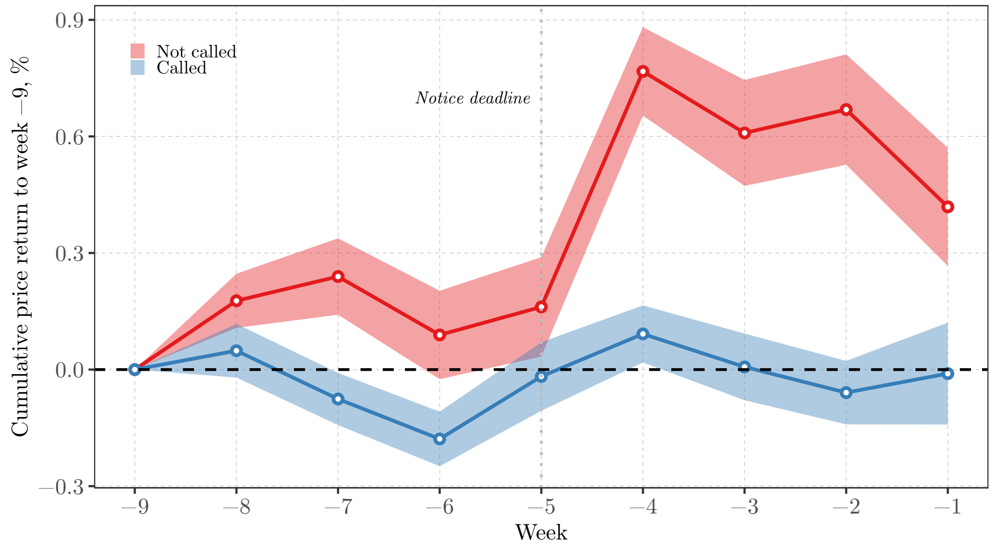

Figure 3: Bond price dynamics around call notice dates for in-the-money bonds
On the y-axis is the percentage change in the average weekly bond clean price (excl. accrued interest) relative to a reference week '-9', which corresponds to the days from -64 to -58 (inclusive) on the event timeline in Figure 1. The bonds that did not trade in week -9 are excluded from consideration. Week '-5' corresponds to days -37 to -30 and ends with the call notice deadline; hence, it is the 'call notice' week. The sample is from 2010 to 2023 here. The shaded areas are two standard deviations around the cross-sectional average.

Figure 3 plots a week-by-week bond price dynamic for ITM bonds in the post-GFC period. A (no-)call notice arrives in week -5. This is when the uncertainty about a possible call in week 0 is resolved. Weeks -9 to -6 (inclusive) comprise the pre-notice period, and weeks -4 to -1 – represent the post-notice period. The return is a cumulative return relative to week -9. The plot demonstrates that the dynamics of both called and not-called ITM bonds are similar pre-notice. The bonds that are eventually called perform slightly worse pre-notice, but the difference is modest and disappears almost completely right before notice. However, not-called bonds grow in value immediately after the no-call notice – in line with the estimates in Table 5. The difference in cumulative returns relative to called ITM bonds is at levels above 60 b.p. in weeks -4 to -2 and only then subsides to around 40 b.p.

To single out the component of a surprising (no-)call decision in excess event returns, we estimate regression models that control for diverse confounding factors. These empirical models have the following structure:

$$
\begin{aligned}
XR_i = &\underbrace{\beta_1 \mathbf{1}_i^{\text{ITM}} + \beta_2 \mathbf{1}_i^{\text{ATM}} + \beta_3 \mathbf{1}_i^{\text{OTM}}}_{\text{Average return with expected (no-)call}} + \\
&\underbrace{\beta_4 \mathbf{1}_i^{\text{Surprise}} \mathbf{1}_i^{\text{ITM}} + \beta_5 \mathbf{1}_i^{\text{Surprise}} \mathbf{1}_i^{\text{ATM}} + \beta_6 \mathbf{1}_i^{\text{Surprise}} \mathbf{1}_i^{\text{OTM}}}_{\text{Additional return due to a surprise decision}} + \\
&\{\text{News about bond issuer and Bond investors' market impact}\} + \\
&\{\text{Bond- and firm-level controls, FEs, ...}\} + \epsilon_i. \qquad (4)
\end{aligned}
$$

Above, dummy variables $\mathbf{1}^{\text{ITM}}, \ldots, \mathbf{1}^{\text{OTM}}$ capture average excess returns associated with different levels of embedded option moneyness. $\mathbf{1}^{\text{Surprise}}$ is another dummy variable that takes the value of 1 for ITM/ATM no-calls and for OTM calls (and is 0 otherwise). The loadings $\beta_4, \ldots, \beta_6$ on the interactions of dummy variables $\mathbf{1}^{\text{Surprise}} \times \mathbf{1}^{\text{ITM}}, \ldots, \mathbf{1}^{\text{Surprise}} \times \mathbf{1}^{\text{OTM}}$ represent the excess return associated with a surprising (no-)call decision above and beyond the average return associated with the respective level of moneyness.

Furthermore, in (4) we control explicitly for two alternative factors of event returns that are potentially unrelated to pure (no-)call surprises. The first is public news about the bond issuer as proxied by the return on the issuer's common stock in the event window (cumulative return from day -37 to day -2 on the event timeline in Figure 1). Positive news about the issuer released in the event window might increase both its equity and debt value. We control for this factor of event returns to the extent that stock prices reflect public news about the bond issuer.[19] The second factor is the market impact of investors rebalancing from and to sample callable bonds around the (no-)call notice event (we describe the phenomenon statistically in Section 3). Regardless of the ultimate reason for trading bonds around notice events, each such trade would have a market impact in a relatively illiquid retail notes market. To control for such market impact, we include the change in the average daily net volume (customer purchases from dealers in excess of customer sales to dealers), $\Delta ADNV$, post-event to pre-event, in the regression models. We rely on bond-level controls and sets of fixed effects for residual issue-, issuer-, and time-specific effects in excess event returns.

[19] In Table 4, we established that equity returns in the event window are unrelated to call decisions.

Table 6 presents the estimates from models (4). Model (1) in Table 6 is essentially the same as the full-sample model in Table 5 with the relative effect of a surprising call decision within each moneyness class put forward and standard errors clustered in time. An ITM no-call is associated with a 25 b.p. additional excess return which is insignificant in the full sample before additional factors of returns are accounted for. Model (2) adds the equity return within the event window to the regression model, and it contributes strongly and significantly. A 1% equity price jump relates to an 18 b.p. bond price appreciation — the effect remains almost unchanged for all subsequent model specifications. The equity return alone explains 13% of cross-sectional variation in event returns.[20] Importantly, after controlling for the equity return, the effect of ITM no-calls becomes stronger (both economically and statistically) and reaches 59 b.p. On the contrary, the OTM-call effect becomes less pronounced and shrinks to 44 b.p. (and becomes insignificant). In models (3)-(6), we further add changes in investor flows and additional controls and fixed effects. Once such confounding factors are accounted for, the loading on $\mathbf{1}^{\text{Surprise}} \times \mathbf{1}^{\text{ITM}}$ increases further to 88 b.p. (model 6) while the loading on $\mathbf{1}^{\text{Surprise}} \times \mathbf{1}^{\text{OTM}}$ drops to 34 b.p.

Models (7)–(9) in Table 6 exploit the fact that for many issuers there are many bonds simultaneously outstanding. Hence, it is possible to statistically identify the (no-)call effect on XR controlling for the variation in returns that is due to time-varying issuer-level characteristics without specifying the latter ones explicitly. For this, we introduce issuer×year dummies in the regression model (4). Such fixed effects jointly absorb the impact of *all* issuer-level factors varying year-by-year on excess event returns. In models (7)–(9), the ITM no-call remains strongly statistically significant and is even higher in magnitude than in the previous models. In model (9), the ITM no-call is associated with 100 b.p. excess return, which is about 60 b.p. greater than the excess return in ATM no-calls, which is, in turn, about 40 b.p. greater than the OTM-call excess return (the latter two are insignificant). As we show formally in the next section, a large and positive ITM no-call return can be explained by a missed exercise opportunity which reduces the value of the issuer-held bond call option (and hence increases the bond price for the investor). The same applies to ATM

[20]For some issuers, there are many outstanding bonds. Hence, the events overlap, which mechanically drives the marginal R^2 of the equity return up.

	Dependent variable: XR								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\mathbb{1}^{\text{Surprise}} \times \mathbb{1}^{\text{ITM}}$	0.25	0.59**	0.60**	0.69**	0.73**	0.88**	0.90*	0.93**	1.00***
	(0.26)	(0.27)	(0.29)	(0.30)	(0.32)	(0.35)	(0.49)	(0.47)	(0.37)
$\mathbb{1}^{\text{Surprise}} \times \mathbb{1}^{\text{ATM}}$	−0.01	0.03	0.04	0.14	0.06	0.15	0.80*	0.74*	0.42
	(0.31)	(0.26)	(0.26)	(0.22)	(0.24)	(0.23)	(0.43)	(0.44)	(0.39)
$\mathbb{1}^{\text{Surprise}} \times \mathbb{1}^{\text{OTM}}$	0.81*	0.44	0.43	0.58	0.56	0.34	−0.24	0.16	−0.02
	(0.40)	(0.41)	(0.42)	(0.39)	(0.39)	(0.41)	(0.54)	(0.48)	(0.57)
Equity return		0.18***	0.18***	0.20***	0.19***	0.19***			0.20***
		(0.02)	(0.02)	(0.02)	(0.02)	(0.02)			(0.02)
$\Delta ADNV$			−0.003	0.01	0.01	0.01			0.02**
			(0.02)	(0.01)	(0.01)	(0.01)			(0.01)
$\mathbb{1}^{\text{ITM}}$	0.23*	0.05	0.04						
	(0.13)	(0.11)	(0.13)						
$\mathbb{1}^{\text{ATM}}$	0.06	0.16	0.15	0.12	0.31	0.30	−0.13	0.02	0.14
	(0.20)	(0.21)	(0.21)	(0.23)	(0.25)	(0.27)	(0.34)	(0.34)	(0.29)
$\mathbb{1}^{\text{OTM}}$	0.40***	0.27	0.27	0.15	0.24	0.30	0.97*	1.15**	0.40
	(0.14)	(0.19)	(0.20)	(0.21)	(0.30)	(0.31)	(0.55)	(0.55)	(0.44)
Bond controls	NO	NO	NO	YES	YES	YES	NO	YES	YES
Year FE	NO	NO	NO	NO	YES	YES	NO	NO	NO
Issuer FE	NO	NO	NO	NO	NO	YES	NO	NO	NO
Issuer×Year FE	NO	NO	NO	NO	NO	NO	YES	YES	YES
Observations	13,452	11,167	11,164	11,164	11,164	11,164	13,052	13,052	10,822
Adjusted R^2	0.0004	0.13	0.13	0.17	0.18	0.18	0.09	0.11	0.20

Note: *p<0.1; **p<0.05; ***p<0.01

Table 6: Event return and call decision surprise (full sample)
The underlying empirical model is equation (4). "Surprise" is a no-call for the ITM or ATM bonds and a call for the OTM bonds. Equity return is the percentage return on the issuer's publicly traded stock in the event window. $\Delta ADNV$ is the change in the average daily net volume, within-event to pre-event, in b.p. of the outstanding amount. Bond controls are the bond outstanding amount, maturity, coupon, and credit rating dummies. Models (7)–(9) are for issuer–years with at least ten events. Standard errors are clustered by issuer. Alternative return metrics and subsamples are in Appendix in Table A8 (IG and HY separately), Table A5 (post-GFC sample, XR return), Table A6 (post-GFC sample, xr return), and Table A7 (post-GFC sample, XRS^n return).

no-calls, but here the option value is lower before the notice; hence a smaller effect. The OTM call should be, on the one hand, a piece of good news to investors (they are paid more than the fundamental value of the bond), but, on the other hand, it is a realization of a re-investment risk as investors suddenly own a short-duration riskless bond rather than a long-term high-yielding one. This might explain the lack of significant OTM surprise in most models of Table 6.

The estimates of model (4) on different subsamples of the data and under different definitions of key variables provide additional evidence for a strong association between an ITM no-call and the excess event return. We run several such robustness tests for the main empirical result of the paper and present the results in the Appendix. In particular, we show that:

- The results become stronger if we exclude transactions below $10k notional amount from the calculation of average bond prices (Table A4). This suggests that the main result is not driven by micro-trades that are occasionally executed at large premia or discount to the prevailing market price (Feldhütter 2012).

- The results are stronger in the post-GFC part of the sample (Tables A5 and A6), both for headline excess returns (XR) and for duration-adjusted excess returns (xr).

- The results hold when the excess returns are measured relative to duration-matched returns of *non-callable bonds of the same issuer* within the event window, XRS^n (Table A7). We observe such same-issuer non-callable benchmark for only about 3k events in the sample. Yet, even in this smaller sample, the event return component associated with an ITM no-call surprise is between 33 and 71 b.p. across different model specifications. If a decision not to exercise an ITM bond call option reveals some fundamental information about the bond issuer, it must be priced similarly in the issuers' duration-matched callable and non-callable bonds. The fact that we find a sizeable effect that is specific to a callable bond only suggests that a pure re-valuation of the embedded call option plays a substantial role in the observed event return.

- The ITM-no-call return is statistically stronger in investment-grade bonds, while the economic magnitude of the effect is higher among the high-yield ones (Table A8).

- The results hold for financial and non-financial firms, each comprising about half of the sample (Table A9). The magnitude of the ITM-no-call return is greater for financial firms.

In this section, we presented evidence that suggests that investors re-price callable bonds following missed call exercise opportunities. The effect is specific to bonds with in-the-money embedded call options and extends beyond the effect of confounding event return factors. We do not claim that the issuers always behave sub-optimally when they do not exercise ITM calls (though the evidence of the previous section points to some degree of sub-optimality in call decisions) – it still could be that there are unobserved (to us and/or investors but not to the issuer) bond-specific factors that drive ITM no-calls. However, we showed that investors re-price not-called ITM bonds in a manner consistent with a value transfer from issuers to bondholders.

2.3 Callable bond price and missed exercise: a simulation

The question is, by how much would a callable bond price jump if the bond was not called? Although we are aware of the most advanced models such as Jarrow *et al.* (2010) (where the authors model the term structure of risk-free assets with two factors, an additional factor captures the credit spread, and one more factor for the early exercise), we instead rely on a very simple setting since our goal is just to obtain an order of magnitude of the price variation upon non-exercise. In our model, the fundamental uncertainty is driven by a one-factor CIR model. This source of uncertainty drives the term structure and, thus, the price of a bond. We assume that the bond can be called at each coupon payment date. The issuer faces a tradeoff between calling or leaving the option to call open. Before the potential exercise date, investors assume that the firm calls when it is rational to do so. This determines the market value of the firm. In our model, we explicitly model the optimization of the manager and do not need to rely, as in Jarrow *et al.* (2010), on some latent factor determining exercise. Furthermore, we consider a Bermudan setting with discrete times, for calling the bond, instead of an American setting where calling a bond over a window of time is required. This means that we do not need to rely on settings such as those in Ibáñez and Zapatero (2004) or Ibáñez and Paraskevopoulos (2010).

Formally, this translates into the following. The interest rate dynamic is given by the square root process, also called the CIR process, and introduced by Cox *et al.* (1985). Let r_t be the instantaneous interest rate at time t. This will be our single risk factor. We assume the following risk-neutral dynamic for r_t

$$\mathrm{d}r_t = \kappa(\theta - r_t)\mathrm{d}t + \sigma\sqrt{r_t}\mathrm{d}W_t^*.$$

In this equation, κ, $\theta > 0$, and $\sigma > 0$ are constant parameters. The parameter θ has the interpretation of being a long-term interest rate level. κ is the speed of mean reversion. A greater value of this parameter means that interest rates that deviate from the long-run mean will return faster to the long-run mean. σ represents the volatility of mean-reversion. By $\mathrm{d}W_t^*$, we denote an increment of a Brownian motion over an elementary time increment $\mathrm{d}t$.

It has been shown in Cox *et al.* (1985) that the discount factor, i.e,. the price at t of a zero-coupon bond paying 1 at T, is given by

$$\begin{aligned} Z(t,T) &= e^{A(t,T)-r_t\,B(t,T)} \\ A(t,T) &= \frac{2\kappa\theta}{\sigma^2}\ln\left(\frac{2he^{\frac{h+\kappa}{2}(T-t)}}{(h+\kappa)\left(e^{h(T-t)}-1\right)+2h}\right) \\ B(t,T) &= \frac{2\left(e^{h(T-t)}-1\right)}{(h+\kappa)\left(e^{h(T-t)}-1\right)+2h} \end{aligned}$$

where $h = \sqrt{\kappa^2 + 2\sigma^2}$.

The price of a non-callable plain vanilla coupon bond with semiannual coupons can then be determined as follows. Assume that the coupon payment dates are T_i for $i = 1, \cdots, N$. Let F be the face amount to be paid at maturity. Define c as the constant coupon rate. The price of the bond can be easily obtained using the discount factors above, with

$$B(t) = \sum_{i=1}^{N}\frac{cF}{2}Z(t,T_i) + FZ(t,T_N)$$

The price of a callable coupon bond with semiannual coupons adds at coupon payment dates an additional choice for the issuer: should the bond be called? In practice, there may be a certain initial period of time where the bond cannot be called. In any case, the price of the bond is then valued by backward induction. There are also make-whole bonds that, upon call, pay to the holder of the bond the present value of the future cash flows. In this section, we are more interested in non-make-whole bonds that pay their owner only the face value. The case where the bond pays a (small) premium above the face value in the case of exercise is similar in treatment. Thus, for simplicity, we assume here that the bond issuer needs to consider the present discounted value of the future cash flows the bond represents and the strike price, here assumed to be F.

At maturity date T_N, the bond issuer must pay F and the last coupon. The value of the callable bond is thus

$$V_c(T_N) = F + \frac{cF}{2}.$$

At any time $T_i < T_N$, the bond issuer needs, first, to pay a coupon. Then, the issuer has the choice between calling or waiting and does so based on the continuation value of the instrument.

$$V_c(T_i) = \min(F, Z(T_i, T_{i+1})V_c(T_{i+1})) + \frac{cF}{2}.$$

Intuitively, if the bond price has increased over time because of a decrease in the general level of interest rates, the present value of the future coupons and repayment of F may be higher than the par value F. In such a situation, it would be of interest for the issuer to call the option and possibly refinance at some lower cost. When the option is ITM, market participants should expect the worst, which means an early exercise. In such a case, the investors only receive F. No rational buyer should pay a price higher than F if the call is ITM. In the case when an option is not called, we call the price jump the difference between the price after the issuer has decided not to call and F.

Presently, we turn to the simulation. It turns out that simulating the CIR process is not a trivial task, especially if one seeks efficiency. We rely on the discussion in Okhrin *et al.* (2022) and retain the QE algorithm of Andersen (2008).[21] For each scenario, We simulate 10,000 trajectories. The entire simulation lasts a fraction of a second. We present our findings in Table 7. The top part of the table presents the parameters chosen. We hold the long-run

[21] One may find codes on how to simulate the CIR process in the following GitHub repository: https://github.com/mrockinger/CIR-Heston-Simulation.

level of interest rates constant at 5%. This parameter does not affect the overall picture. We have a scenario with fast mean reversion, $\kappa = 10$, and another with slow mean reversion, $\kappa = 3$. We also have scenarios with lower (7%) and higher (20%) volatility of interest rates. The case of $\kappa = 3$ and $\sigma = 7\%$ aligns with the estimates in Duffee (1999) (treating r_t as an instantaneous yield spread process).[22] Time moves forward from the issue date to the penultimate period $T_N - 0.5$ by steps of a half year. $T_1 = 0.5$ corresponds to the first coupon date. The column 'NbC' expresses the percentage of situations in which the callable bond should have been rationally called. 'Mean' is the average price jump of the bond if the issuer does not call. 'Mean (10% max)' is the average price jump within the 10% largest price jumps.

κ	10			3			10		
θ	5%			5%			5%		
σ	7%			7%			20%		
T_i	NbC (%)	Mean	Mean (10% max)	NbC (%)	Mean	Mean (10% max)	NbC (%)	Mean	Mean (10% max)
0.5	30.64	0.133	0.58	28.05	0.238	0.92	25.26	0.351	1.48
1.0	32.37	0.135	0.55	28.82	0.248	1.01	25.75	0.342	1.48
1.5	33.98	0.132	0.66	30.32	0.242	1.07	26.92	0.354	1.49
2.0	35.85	0.136	0.64	32.04	0.247	1.09	28.16	0.346	1.57
2.5	37.84	0.133	0.55	34.36	0.247	1.02	29.95	0.357	1.63
3.0	39.30	0.135	0.64	36.55	0.245	1.01	32.71	0.353	1.75
3.5	42.42	0.136	0.60	39.82	0.247	1.14	36.16	0.369	1.53
4.0	46.87	0.138	0.60	44.28	0.246	1.17	41.57	0.359	1.51
4.5	57.22	0.152	0.42	56.09	0.254	0.70	54.01	0.385	1.05

Table 7: Option price jumps following missed exercise opportunities in a calibrated CIR model. This table displays for selected values of the parameters for different times to maturity statistics of the price-jumps. NbC is the percentage of the 10'000 simulations where the issuer should have rationally called the bond. Mean is the average price jump if the issuer of the callable bond decides not to call the bond. To get an idea of the upper bound of the option value we also present 'Mean (10% max)' which is the average over the 10% largest price jumps .

Our findings correspond to what economic intuition suggests: as time passes, interest rates drift from their starting value, and this creates more situations where the bond should be called. Decreasing κ from 10 to 3 means that the series reverts less toward the mean. As

[22]We reestimated the model of Duffee (1999) in a recent TRACE sample and found similar parameter values for a median bond. However, there is substantial variation in parameter estimates in the cross-section of bonds.

interest rates drift further from the starting value (set at the long-term rate), this increases the option value of the call and, therefore, the price jump in the case of no call. Similarly, if one increases the volatility from 7% to 20%, the option value of the call increases and the price jump upon non-exercise is higher. The sizes of price jumps in Table 7 are generally in line with the effects we observe in the data. In a slow mean reversion case with low volatility, the price jump following no-exercise is approximately 25 b.p. In the data, we find the average price jump of approximately 40 b.p. (or more if the confounding factors are accounted for), which can be matched by adjusting the volatility σ upward, as the case of $\sigma = 20\%$ demonstrates. In this latter case, the price jumps in the model are approximately 35-39 b.p. depending on bond maturity. This simulation exercise highlights that in the classic no-arbitrage pricing framework, the suboptimal no-exercise of a callable bond generates price jumps that broadly match those observed in our event study.

3 Trading around call notices

In this section, we further quantify changes in investor demand for callable bonds around (no-)call notices and the excess returns on a portfolio of such bonds. For this, we first investigate trading volume patterns in the event window and then regress excess callable portfolio returns on systematic bond risk factors. Ultimately, we demonstrate in this section that liquidity providers (here, dealers) that purchase callable bonds pre-notice and hold them until the call uncertainty is resolved pocket a sizeable return above 50 b.p. per month (post-GFC).

3.1 Investor flows

A trading volume metric that we analyze is the 'average daily net volume' or $ADNV$. We calculate the $ADNV$ for a given bond the following way. The $ADNV$ is the difference between the average daily buy and sell volumes. The average daily buy volume is the total dollar amount of all purchases by clients from dealers in a chosen event interval (pre-notice or post-notice), divided by the number of calendar business days in the interval. Similarly, the average daily sell volume is the total amount of sales by dealers to clients divided by the number of business days. On average, there are approximately 20 business days in both pre- and post-notice periods. On some of those days, there is no trading activity (see Table 1, Panel E). Hence, our measure of the $ADNV$ represents what net investors' purchases would be if the bonds were traded every business day. As opposed to a total net purchase, the $ADNV$ corrects for a different number of business days in the cross-section of bond-events. To render $ADNV$ comparable across bonds, we represent it as a fraction of the outstanding bond amount. The difference between post- and pre-notice $ADNV$ measures the change in investors' demand for a bond in the post-notice period relative to the pre-notice period.

Table 8a presents the regressions of a pre-event $ADNV$ on the combination of moneyness and call outcome dummies. Here, the regression model is similar to the returns model (3), but the left-hand side is now a bond-event-specific $ADNV$:

$$ADNV_i^{\text{pre}} = \gamma_1 \mathbf{1}_i^{\text{OTM}} \times \mathbf{1}_i^{\text{Not called}} + \cdots + \gamma_6 \mathbf{1}_i^{\text{ITM}} \times \mathbf{1}_i^{\text{Called}} + \epsilon_i. \tag{5}$$

The estimates $\hat{\gamma}_1, \ldots, \hat{\gamma}_6$ measure the average net demand for callable bonds depending on the moneyness of the embedded option and whether the bonds were or were not called.

We find that investors are net sellers of callable bonds in the pre-notice period (Table 8a). The average $ADNV^{\text{pre}}$ is significantly negative in the full sample and in subsamples, except for the case of OTM bonds that are eventually called. Post-GFC, which is arguably the most homogeneous economic period of our sample, the $ADNV$ varies roughly between -0.50 and -0.10 b.p. of the outstanding amount according to the third column of Table 8a. A negative $ADNV$ reading is, by construction, an increase in total dealers' inventory. Therefore, we document that, as a result of pre-event trading, dealers have more exposure to sample callable bonds right before the notice deadline than at the beginning of the event window.[23]

Table 8b presents the estimates from a model similar to (5), but the left-hand side variable is now a change in the $ADNV$ post-notice relative to pre-notice. It represents the change in net investor demand for bonds from different moneyness categories *after* the uncertainty about the nearest call decision is resolved. The estimates in Table 8b have a very clear pattern: investors are selling the bonds that were called, regardless of the pre-event

[23] The economic magnitude of such change in bond ownership is relatively modest. For instance, the $ADNV$ of -0.19 b.p. translates into total net investor sales of approximately 4 b.p. pre-notice.

	Dependent variable: $ADNV^{\text{pre}}$		
	Full sample	Ex-GFC	Post-GFC
ITM × Not-called	-0.19^{***}	-0.19^{***}	-0.19^{**}
	(0.06)	(0.06)	(0.07)
ITM × Called	-0.16^{*}	-0.16^{*}	-0.09
	(0.08)	(0.08)	(0.08)
ATM × Not-called	-0.27^{**}	-0.32^{**}	-0.34^{**}
	(0.13)	(0.13)	(0.13)
ATM × Called	-0.48^{***}	-0.48^{***}	-0.49^{***}
	(0.14)	(0.14)	(0.15)
OTM × Not-called	-0.15^{***}	-0.26^{***}	-0.22^{*}
	(0.05)	(0.06)	(0.12)
OTM × Called	-0.36	-0.34	-0.10
	(0.31)	(0.40)	(0.44)
Observations	13,464	10,600	7,882
Note:	*p<0.1; **p<0.05; ***p<0.01		

(a) Pre-event $ADNV$

	Dependent variable: $\Delta ADNV^{\text{post-pre}}$		
	Full sample	Ex-GFC	Post-GFC
ITM × Not-called	0.16	0.16	0.18
	(0.11)	(0.11)	(0.11)
ITM × Called	-3.03^{***}	-3.03^{***}	-2.48^{***}
	(0.53)	(0.53)	(0.42)
ATM × Not-called	0.49^{**}	0.57^{**}	0.59^{**}
	(0.22)	(0.23)	(0.25)
ATM × Called	-1.84^{***}	-1.83^{***}	-1.51^{***}
	(0.32)	(0.34)	(0.35)
OTM × Not-called	0.13	0.34^{*}	0.49^{***}
	(0.17)	(0.19)	(0.17)
OTM × Called	-2.82^{***}	-2.83^{**}	-2.10^{**}
	(0.77)	(1.13)	(0.95)
Observations	13,461	10,597	7,879
Note:	*p<0.1; **p<0.05; ***p<0.01		

(b) $\Delta ADNV$, post-event to pre-event

Table 8: Trading volume by option moneyness and call decision
The regression model is $V_i = \beta_1 \mathbf{1}_i^{\text{ITM}} \times \mathbf{1}_i^{\text{Not called}} + \cdots + \beta_6 \mathbf{1}_i^{\text{OTM}} \times \mathbf{1}_i^{\text{Called}} + \epsilon_i$, where $\mathbf{1}^{\mathcal{M}}$ is the dummy that takes the value of 1 if condition $\mathcal{M}$ is satisfied and 0 otherwise. In Panel (a), the dependent variable is the average daily net volume ($ADNV$, client purchases from dealers minus client sales to dealers, in b.p. of the outstanding amount) calculated across all calendar business days (incl. zero-trading days). In Panel (b), the dependent variable is the change in the $ADNV$ post- to pre-event. The 'Ex-GFC' sample excludes the years 2008 and 2009 from consideration. The 'Post-GFC' sample is from 2010 to 2023. The standard errors are clustered by issuer.

moneyness, and buying back the uncalled ones. The change in the *ADNV* is the order of magnitude greater (in absolute value) for called than for not-called bonds. For instance, in the post-GFC sample, additional investor sales of called ITM bonds to dealers amount to approximately 2.5 b.p. of the outstanding amount per business day. Recall from Table 5 that there was no price effect associated with such sales (since the call is already priced in pre-notice, the transactions are at prices very close to the call price). Consider now a change in the *ADNV* for not-called ITM bonds post-GFC (the third column of Table 8b). Investors increase net purchases of such bonds by 0.18 b.p. of the outstanding amount per day (a statistically insignificant effect), approximately matching what they sold to dealers pre-notice. We have already established in Table 6 that the price impact of such sales and purchases accounts for a part of the excess event return. What Table 8 adds to the results is that the dealers hold more callable bonds in the event window than they normally do otherwise. Hence, the excess return on a portfolio of non-callable bonds is the dealers' remuneration.[24]

3.2 Callable portfolio returns

In this section, we further characterize the return of a portfolio of either all callable or only ATM and ITM bonds.[25] The purpose of the section is twofold. First, we show that the portfolios of callable bonds generate returns above and beyond the exposure to corporate bond pricing factors. Second, we discuss the practical limitations of the strategy.

We construct callable bond portfolios the following way. The scheduled call dates are known in advance for each bond in the sample. Once the bond enters the pre-notice period, as defined in Figure 1, its moneyness is evaluated (which does not require any forward-looking information). The bonds are purchased into the portfolios at $\bar{P}_i^{\text{pre}}$ and are held until the post-notice period when they are sold at $\bar{P}_i^{\text{post}}$. Portfolio weights are proportional to bond outstanding amounts. That is, we consider size-weighted portfolios.[26] We attribute

[24]There has been a steady growth in non-dealer liquidity provision after the GFC (see, for instance, Adrian *et al.* 2017), but in our sample of retail notes, it is mostly traditional sell-side bond dealers that provide liquidity to the market.

[25]The results are stronger for a portfolio of only ITM bonds, but such a portfolio sometimes has too few holdings. Hence, we consider a more diversified one.

[26]The results are quantitatively very similar for equally weighted portfolios (unreported).

the resulting return to the months of scheduled call dates. This means that, on average, the bonds stay in the portfolio for approximately a month.

	All callable			ATM/ITM callable		
	Full sample	Pre-GFC	Post-GFC	Full sample	Pre-GFC	Post-GFC
Mean (% month)	0.53	0.15	0.69	0.24	0.18	0.51
Std. dev. (% month)	5.06	3.32	2.13	3.01	3.01	2.16
Sharpe (annualized)	0.36	0.16	1.13	0.27	0.20	0.81
Min. (% month)	-32.06	-10.13	-9.66	-19.93	-11.27	-9.84
Max. (% month)	25.80	7.68	7.58	6.40	6.35	5.02
Avg. no. bonds	57	44	52	25	11	32

Table 9: Excess return characteristics of size-weighted callable bonds portfolios The portfolios consist of either all callable bonds in the sample or at/in-the-money bonds. We assume here that portfolio bonds are bought at the average pre-notice price and sold at the post-notice price. Portfolio weights are bond outstanding amounts. The resulting return is attributed to the month into which the latest possible call notice date (day -30 on Figure 1) falls. This table calculates performance metrics for excess returns (XR). Transaction costs are not accounted for. The pre-GFC period is 2002–2007, and the post-GFC is 2010–2023.

Table 9 presents summary statistics of the time series of excess portfolio returns XR. van Binsbergen *et al.* (2023) argue that such a metric is the proper way to evaluate excess returns on individual bonds and bond portfolios with a duration longer than several months. Our main focus is the portfolio of ATM/ITM bonds (the last three columns of Table 9), but we also present the characteristics of a portfolio of all callable bonds as a reference. In line with previously reported results in Table 2, we find that at 51 b.p. per month, excess returns on the portfolio of ATM/ITM bonds are large and positive in the post-GFC sample. Pre-GFC, the excess return is 18 b.p. per month. The ATM/ITM portfolio's gross Sharpe ratio is around 0.8 post-GFC, similar to many systematic corporate bond strategies in the same period (Ivashchenko and Kosowski 2024). The notice-driven portfolio of all callable bonds (incl. OTM bonds, the first three columns of Table 9) demonstrates even stronger risk-adjusted performance post-GFC.

Importantly, the ATM/ITM portfolio holds, on average, 32 bonds (post-GFC). This is a relatively small number, which implies certain costs and benefits. The cost is, potentially, an under-diversification of idiosyncratic risks of individual corporate bond holdings (although the portfolio of all callable bonds in the sample has a comparable return volatility, according to Table 9). A potential benefit of fewer portfolio holdings is a smaller transaction cost, which is highly important for such a high-turnover portfolio. It is important to recall that our sample consists of retail notes with relatively small outstanding amounts; therefore, the capacity of such an ATM/ITM portfolio is limited, and the portfolio may be of interest only to small institutional or retail investors. Such investors would be trading primarily in retail amounts (up to $100k, a usual threshold for institutional transactions in this market), which is particularly costly. Ivashchenko and Kosowski (2024) estimate an average one-way transaction cost for retail-sized corporate bond trades at approximately 30 b.p., which implies a roundtrip cost (60 b.p.) that fully offsets the gross excess return on the ATM/ITM portfolio (51 b.p.). Prior studies such as Bessembinder *et al.* (2018) estimate retail-sized bond trading costs even higher at above 100 b.p.

For profitable practical implementation, one has to optimize the transaction costs to make the ATM/ITM portfolio generate positive net returns. Otherwise, the dealers pocket the excess return on callable bonds through transaction costs. As we discussed in Section 3, the dealers are themselves investors in such callable bond portfolios. We found that dealers are net buyers of bonds pre-notice and are net sellers post-notice. From this standpoint, Table 9 documents the returns to the dealers' inventory of callable bonds held during the notice period.

Table 10 presents performance attribution regressions for the time series of ATM/ITM portfolio returns. Corporate bond pricing factors here are from Dickerson *et al.* (2023a).[27] As previously discussed, the notice return phenomenon is the most pronounced after the GFC: the ATM/ITM portfolio generates a significantly positive return above the exposure to common bond pricing factors in the years 2010–2023. The part of the ATM/ITM portfolio return unexplained by the exposure to the corporate bond market and illiquidity risk factors is between 52 b.p. (XR) and 67 b.p (R) post-GFC. The portfolio has no exposure to either market or liquidity factor, suggesting that callable bonds' price fluctuations around scheduled notice days are unrelated to economic and bond market fundamentals.

[27]The factor structure in the cross-section of corporate bonds is a subject of an active academic debate (other important contributions are Dickerson *et al.*, 2023b and Dick-Nielsen *et al.*, 2023). Here, we rely on the result of Dickerson *et al.* (2023a) that of many factors proposed by the previous literature only the market factor and, to a lesser extent, the liquidity factor are the robust ones.

	Dependent variable: R_i				Dependent variable: XR_i			
	Full sample		Post-GFC		Full sample		Post-GFC	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	0.44**	0.44**	0.67***	0.67***	0.28	0.28	0.52***	0.52***
	(0.17)	(0.17)	(0.12)	(0.12)	(0.20)	(0.20)	(0.18)	(0.18)
MKTB (market)	−0.01	0.02	0.11	0.12	−0.11	−0.11	−0.04	−0.001
	(0.09)	(0.12)	(0.07)	(0.09)	(0.11)	(0.13)	(0.11)	(0.14)
LRF (liquidity)		−0.11		−0.02		0.01		−0.11
		(0.20)		(0.15)		(0.23)		(0.23)
Observations	235	235	149	149	235	235	149	149
R^2	0.0001	0.001	0.02	0.02	0.004	0.004	0.001	0.002

Note: *p<0.1; **p<0.05; ***p<0.01

Table 10: Factor exposure of the ATM/ITM callable bond portfolio
The dependent variable is either the headline return R_i or the spread return XR_i (both in % per month) on a monthly-rebalanced size-weighted portfolio of ATM and ITM callable retail notes. Market and liquidity corporate bond factors are from Dickerson *et al.* (2023a). The market factor is the return on a broad, size-weighted corporate bond portfolio. The liquidity factor is the average long-short return on size-weighted portfolios double-sorted on bond credit rating and Bao *et al.* (2011) bond illiquidity measure. The full sample is 2002–2023; the post-GFC sample is 2010–2023.

Figure 4 plots the cumulative return on the ATM/ITM callable bond portfolio. The plot demonstrates yet again that before the GFC, the portfolio was not generating sizeable excess returns (though the dynamic in 2002-2003 and 2006-2007 resembles the post-GFC one). During the GFC, the ATM/ITM portfolio lost almost 40% of its value due to exposure to issuers that went through debt restructuring. Starting mid-2009, the ATM/ITM portfolio has been steadily generating positive returns and almost tripled in value by the end of 2023 (relative to the trough in early-2009). Importantly, the orange line in Figure 4 demonstrates that the excess return component constitutes approximately one-half of the cumulative ATM/ITM portfolio appreciation. This is a remarkable statistic given that van Binsbergen *et al.* (2023) find that only approximately 5-10% of the performance of a representative corporate bond is due to changes in the yield spread. Therefore, we conclude that the portfolio of ATM/ITM bonds is a relevant investment instrument for retail and small institutional investors seeking exposure to risk factors beyond the systematic drivers of the yield curve.

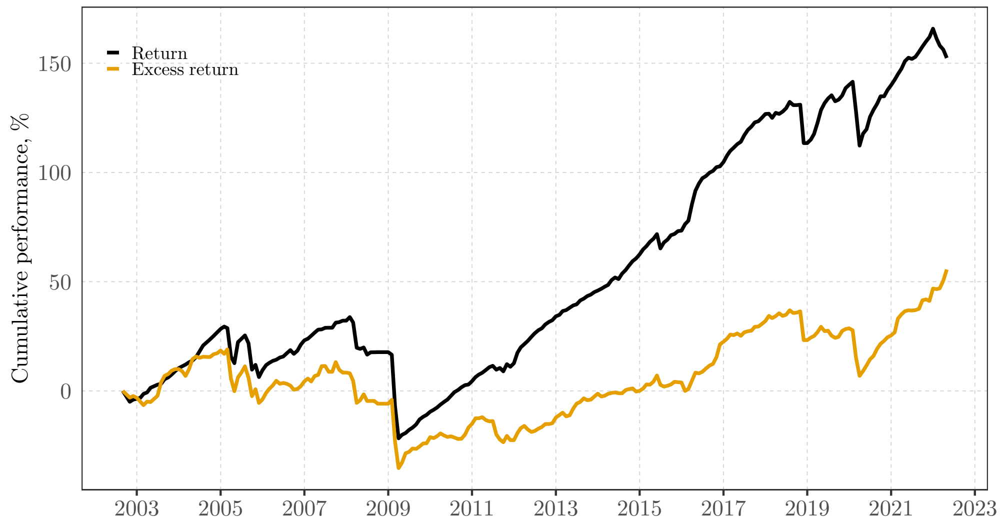

Figure 4: Cumulative returns of the ATM/ITM callable bond portfolio
The portfolio inception date is end-June 2002. On the y-axis is the cumulative return of the size-weighted monthly-rebalanced portfolio of at- and in-the-money callable retail notes. The returns are not adjusted for transaction costs. The return metrics are the headline returns R and the excess return XR. The latest few months of the sample (mid-2022 to mid-2023) are dropped from the plot because there is few call events in that part of the sample.

4 External validity

Our results are in a sample of callable bonds with relatively low outstanding amounts (retail notes). One might wonder whether the results remain valid in a sample of bond issues that institutional investors typically hold. Such institutional-sized bond issues usually have large outstanding amounts and constitute the majority of the dollar value of debt firms raise. Importantly, most (callable) institutional-sized bond issues are continuously callable, making them unsuitable for the event-study analysis we performed in the paper. Moreover, such callable bonds are typically 'make-whole' callables, meaning that the issuer calls not at a fixed price but at a fixed spread to the Treasury yield curve, repaying all remaining coupons at the time of the call. Such embedded make-whole call options are predominantly out-of-the-money (about 98% of the time in the usual TRACE bond-month sample). Hence, we do not observe much variation in option moneyness even at the first date the bond becomes callable.[28] However, here we attempt to use smaller sets of institutional-sized bond issues that still fit into our event-study methodology to establish the external validity of our results.

4.1 Fixed-date calls in institutional-sized bond issues

The key element of our empirical setup is the call notice date, arguably exogenously pre-set at the time of bond issuance. We present the results for bond subsamples within two large classes of institutional-sized bonds that have such pre-set notice dates and a meaningful variation in options moneyness.

- **Corporate debentures** (CDEB): this is a core of the institutional-sized corporate bond market accounting for about 85% of public corporate bond issuance (by notional amount, in years 2000-2023). More than 80% of such bonds are callable, and the call option is predominantly make-whole and continuously exercisable. Yet, a subset of CDEB, *in addition* to a make-whole call option, contains a call provision that allows the issuer to call the bond at fixed prices across dates pre-specified at the time of bond issuance. Such fixed-strike call option is still typically of American type. A prospectus specifies a set of call prices $\{P_1^c, P_2^c, \ldots, P_n^c\}$ and dates $\{T_1, T_2, \ldots, T_n\}$ such that the bond can be called at P_1^c at any time in $[T_1, T_2)$, at P_2^c – at any time in $[T_2, T_3)$, etc. The notice period for such bonds is typically 30 days, as in the main part of the sample. Hence, we treat days $\{T_1 - 30, T_2 - 30, \ldots, T_n - 30\}$ as event days, and the timeline in Figure 1 remains valid with the caveat that the scheduled call date is the *earliest possible* call date (the call can be executed anytime after T_i). We observe about 3.5k events for fixed-price CDEB call options in the TRACE sample (2002-2023) with the average bond notional outstanding about $500mn. We define a no-call as the absence of a call in 3 months after T_i. If the call is delayed but is still within 3 months after T_i, we treat T_i as the event date, which introduces a measurement error in bond returns upon calls. No-call returns remain correctly measured.

- **Corporate medium-term notes** (CMTN): such bonds represent a sizeable part of corporate bond issuance (about 11% between 2000 and 2023, with close to 40% of them

[28] This is typically a few years after issuance.

being callable). They are direct analogs of retail notes (issued by large firms directly to investors via brokers acting as agents, discretely callable at fixed prices) but target institutional rather than retail investors. It would have been reasonable to include CMTNs in the main sample of the paper, but a) their call notice period is typically shorter, at only 5 days, and b) they are very infrequently traded. For this matter, they do not fit well into the event timeline in Figure 1. For CMTNs, we still treat a pre-set latest notice date as the event date but define the event return as the average clean price percentage change from 4 weeks post-notice to 4 weeks pre-notice. If the bond is called, there are only 5 days to observe the transaction price, which is a limiting factor. We have around 500 CMTN events in the 2002-2023 sample for bonds with an average outstanding amount of $100mn.

4.2 Option moneyness and call decisions

We first examine call frequency across moneyness categories (defined the same way as previously) for corporate debentures and medium-term notes. Table 11 presents the results. We find that call frequencies for corporate debentures at different levels of option moneyness are remarkably close to those for retail notes (RNTs) in Table 3. ITM CDEBs are called at 26% of sample events, and OTM calls stand at about 19%: such call frequencies for RNTs are at 28% and 18%, respectively. OTM calls are more prevalent in CDEBs than in RNTs: 10% vs 5% in the full 2002-2023 sample. For CMTNs, calls are less frequent than for RNTs across all moneyness bins, but the call frequency still increases with moneyness. The key takeaway from Table 11 is that in the institutional bond market, as in the previously analyzed retail notes market, there are few bond calls, given the moneyness of the embedded options. More than 70% of deep-in-the-money bonds are not called timely.[29]

Table 12 presents the logit models estimated for the call dummy for the CDEB subset of events (the CMTN subset is too small for a meaningful analysis here). As in Table 4, the goal is to quantify the impact of moneyness on call probability, controlling for factors that may lead the firms to postpone the calls. As in the RNT sample, we find that moneyness is

[29] Beaumont *et al.* (2023) make a similar argument for institutional bond issues and further link it to the relationship between borrowers and large institutional lenders.

	Full sample			Post-GFC		
	OTM	ATM	ITM	OTM	ATM	ITM
No. bond-events	2461	551	504	1323	476	394
no. no-calls	2218	445	373	1141	381	303
no. calls	243	106	131	182	95	91
% called	9.9	19.2	26.0	13.8	20.0	23.1

(a) Corporate Debentures

	Full sample			Post-GFC		
	OTM	ATM	ITM	OTM	ATM	ITM
No. bond-events	494	48	52	490	47	51
no. no-calls	492	45	43	488	44	42
no. calls	2	3	9	2	3	9
% called	0.4	6.2	17.3	0.4	6.4	17.6

(b) Corporate MTN

Table 11: Bond calls and embedded option moneyness: CDEB and CMTN
This table is analogous to Table 3 but looks into different bond sub-classes: corporate debentures (CDEB, panel (a) of the table) and corporate medium-term notes (CMTN, panel (b) of the table). The full sample is from 2002 to 2023. The 'Post-GFC' sample is 2010–2023. OTM, ATM, and ITM stand for, out-of-, at- and in-the-money, respectively. The first three lines are event counts: the total number of scheduled notice dates, the number of events that were bond no-calls, and the number of bond calls. '% called' is the ratio of calls to the sum of calls and no-calls, in %.

the strongest and the robust factor of call probability across different model specifications.[30] We also observe again the offsetting effects of maturity and leverage on call probability: long-maturity bonds and bonds issued by highly-levered firms are less likely to be called. As before, profitable firms are more likely to call. Unlike in the RNT sample, for CDEBs we also observe the link between the call probability and the equity value. Large firms and firms that experience positive equity returns before notice are less likely to call. The former is consistent with the relationship channel (as in Beaumont *et al.* 2023) as large firms' debt issuance depends more on demand from large investors. The latter suggests that firms might try to time the calls, betting on continuing good firm performance.

[30] We can not estimate models with issuer-time fixed effects here because, unlike in the RNT sample, firms typically have at every point in time only a few outstanding CDEB bonds of a particular type we're looking at (fixed-price embedded call option with discrete call price reset dates). Likewise, we can not include variables that require observing at least a few events per bond: the sample shrinks to only a handful of observations then.

	Dependent variable: $\mathbf{P}_i$ [Called]								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Intercept	-1.57^{***}								
	(0.05)								
Intrinsic value (IV)	1.00^{***}	0.81^{***}	0.41^{***}	0.55^{***}	0.61^{***}	0.61^{***}	0.59^{***}	1.12^{***}	1.16^{***}
	(0.08)	(0.10)	(0.11)	(0.12)	(0.12)	(0.12)	(0.13)	(0.26)	(0.27)
Outstanding amount				-0.00	-0.04	-0.01	-0.09^{*}	-0.36	-0.39
				(0.05)	(0.05)	(0.05)	(0.05)	(0.31)	(0.32)
Maturity				-0.35^{***}	-0.32^{***}	-0.30^{***}	-0.29^{***}	-0.77^{**}	-0.80^{**}
				(0.10)	(0.10)	(0.10)	(0.10)	(0.30)	(0.31)
Equity value					0.10^{***}	0.06	0.09^{***}	-0.81^{**}	-0.81^{**}
					(0.04)	(0.04)	(0.03)	(0.32)	(0.36)
Book leverage					-0.13^{*}		-0.14^{**}	-0.68^{*}	-0.68^{*}
					(0.08)		(0.07)	(0.38)	(0.38)
Market leverage						-0.28^{***}			
						(0.10)			
Profit margin							0.46^{***}	0.43	0.43
							(0.10)	(0.28)	(0.27)
Total payout ratio							0.11	-0.07	-0.06
							(0.08)	(0.14)	(0.14)
Equity return (notice)									-0.01
									(0.15)
Equity return (pre-notice)									-0.32^{**}
									(0.14)
Fiscal year-end (dummy)									0.10
									(0.43)
Year FE	NO	YES	YES	YES	YES	YES	YES	YES	YES
Rating FE	NO	NO	YES	YES	YES	YES	YES	YES	YES
Issuer FE	NO	NO	NO	NO	NO	NO	NO	YES	YES
Num. obs.	3516	3516	3481	3481	2635	2626	2465	2465	2447

$^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$

Table 12: Logit model for the call dummy (corporate debentures)
The models in this table are analogous to Table 4, but the bonds are institutional-sized corporate debentures. The dependent variable equals 1 if the bond is called in event i and is 0 otherwise. All right-hand side variables are standardized (have a zero mean and a unit variance) in the cross-section, and all refer to pre-notice averages unless explicitly specified. In such a sample, we rarely observe multiple simultaneous events for different bonds of the same issuer. Hence, we can not estimate the models with issuer×time fixed effects, as in Table 4. The sample period is 2002–2023. Standard errors are clustered by issuer.

However, even the highest loadings on the IV in Table 12 (1.16 in model 9) imply that a just-in-the-money bond ($IV = 4\%$) is only called one-third of the times (holding other factors at their average levels). It takes the moneyness above 30% to raise the call frequency to above 90%. These results are very similar to the ones obtained earlier in the RNT sample: diverse issuer and issue characteristics do not explain a lack of in-the-money bond calls in the data.

4.3 Option moneyness and event returns

In the RNT sample, we established that ITM no-calls lead to the re-pricing of embedded bond call options in a manner consistent with the price effect of a missed profitable call opportunity. In this section, we demonstrate that a similar effect pertains to CDEB and CMTN fixed-call-price bonds.

	Dependent variable: XR							
	Corporate Debentures				Corporate MTN			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\mathbb{1}^{\text{Surprise}} \times \mathbb{1}^{\text{ITM}}$	0.15	0.26	0.39	0.44	1.70***	0.70	1.67***	0.72
	(0.31)	(0.45)	(0.32)	(0.42)	(0.53)	(0.52)	(0.53)	(0.52)
$\mathbb{1}^{\text{Surprise}} \times \mathbb{1}^{\text{ATM}}$	−0.05	0.07	0.06	0.05	0.60	0.40	0.56	0.45
	(0.21)	(0.29)	(0.21)	(0.25)	(0.41)	(0.45)	(0.40)	(0.46)
$\mathbb{1}^{\text{Surprise}} \times \mathbb{1}^{\text{OTM}}$	−0.74***	−0.13	−0.60***	−0.26	0.02	−0.53	0.03	−0.51
	(0.19)	(0.24)	(0.18)	(0.23)	(0.65)	(0.94)	(0.65)	(0.93)
Equity return	0.13***	0.14***	0.11***	0.12***	0.05***	0.06***	0.05***	0.06***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
$\Delta ADNV$	0.02*	0.01	0.01	0.01	0.01***	0.01***	0.01***	0.01***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.002)	(0.002)	(0.002)	(0.002)
$\mathbb{1}^{\text{ITM}}$	0.20		−0.11		−0.27		−0.26	
	(0.20)		(0.17)		(0.40)		(0.41)	
$\mathbb{1}^{\text{ATM}}$	−0.06	0.27	−0.11	0.69	0.16*	−0.40	0.16*	−0.40
	(0.13)	(0.46)	(0.12)	(0.44)	(0.08)	(0.48)	(0.08)	(0.49)
$\mathbb{1}^{\text{OTM}}$	0.64***	0.58	0.50***	1.03**	0.46***	−0.12	0.46***	−0.14
	(0.16)	(0.48)	(0.15)	(0.51)	(0.10)	(0.69)	(0.09)	(0.69)
Sample	Full	Full	2010+	2010+	Full	Full	2010+	2010+
Bond controls	YES	YES	YES	YES	YES	YES	YES	YES
Year, Issuer FEs	NO	YES	NO	YES	NO	YES	NO	YES
Observations	2,659	2,637	1,846	1,842	543	542	537	536
Adjusted R^2	0.13	0.22	0.12	0.21	0.08	0.15	0.08	0.11
Note:	*p<0.1; **p<0.05; ***p<0.01							

Table 13: Event return and call decision surprise: CDEB and CMTN
The underlying empirical model is equation (4). Models (1), (3), (5), and (7) are analogous to model (3) in Table 6 but are estimated on different bonds. Likewise, models (2), (4), (6), and (8) are analogous to model (6) in Table 6. The full sample is from 2002 to 2023. The '2010+' sample is post-GFC: 2010–2023. "Surprise" is a no-call for the ITM or ATM bonds and a call for the OTM bonds. Equity return is the percentage return on the issuer's publicly traded stock in the event window. $\Delta ADNV$ is the change in the average daily net volume, within-event to pre-event, in b.p. of the outstanding amount. Bond controls are the bond outstanding amount, maturity, coupon, and credit rating dummies. Standard errors are clustered by issuer.

Table 13 estimates a few models, as in equation (4), on institutional-sized bonds. Since a) CDEB and CMTN samples are several times smaller than the RNT sample, and b) event returns are not measured here as precisely as for the RNTs due to the different characteristics of notice events described above, these results are only indirectly comparable to the analogous RNT Table 6. Nonetheless, we find that the point estimates of the return effect of ITM no-calls, despite lacking statistical significance, are positive and of similar magnitude as in the RNT sample. Controlling for issuer and year fixed effects, a surprising ITM no-call leads to a 44 b.p. increase in the CDEB bond price and a 72 b.p. increase in the CMTN bond price – broadly in line with point estimates in the RNT sample. Further reassuring similarities between the models in Tables 6 and 13 include the surprise effect declining with moneyness (OTM calls are bad news for bond investors, ATM no-calls are mildly positive news) and a positive association between equity and bond returns in the event window (for the CDEB sample, the economic magnitude of this effect is about 60% of the RNT one). The overall explanatory power of the models is also comparable across different samples. From this, we conclude that the mechanisms underpinning the event returns in the main analysis of the paper likely remain valid in institutional-sized bonds as well.

5 Conclusion

We study the dynamics of callable bond prices around scheduled dates of possible call notices. At each such date, a bond issuer can announce the bond call or do nothing, retaining the option to call the bond later. In the event study, we find that the passage of call notice dates is associated with a substantial bond price appreciation that yields an excess callable bond return of approximately 40 b.p., on average.

We find that the excess event return is primarily due to those bonds that should have been called by the issuer (ITM bonds) but were not called. We proxy for the call probability with a novel measure of embedded call option moneyness, which we calculate as the potential benefit to the issuer from calling the bond and replacing it with a similar non-callable bond. We show that the bond moneyness is the most robust factor of call probability in the data. Nonetheless, issuers infrequently call in-the-money bonds, even after controlling for confounding call factors. Whenever in-the-money bonds are not called, their prices jump. The size of the price jump associated with ITM no-calls extends up to 100 b.p. after other factors of event returns are accounted for. We demonstrate in a calibrated option pricing model that suboptimal exercise decisions imply levels of price jumps similar to those observed in our event study. Therefore, we conclude that traders are pricing ITM bonds as the ones that should be called at the nearest call date, and when that does not happen, the value transfers from bond issuers to bond holders.

By analyzing trading patterns before event dates, we establish that bond investors are net sellers of all callable bonds. Following the passage of notice dates, investors buy back bonds that were not called. Because of the notice-date excess return described above, dealers holding callable bonds in their inventory in the event window gain the price difference. An investor may attempt to mimic the dealers' position, which as we show, generates substantial risk-adjusted returns, but higher transaction costs might annihilate excess returns.

Our paper addresses a recent regulatory concern (U.S. SEC, 2019) about the lack of knowledge regarding options embedded in fixed-income instruments available to retail investors. By characterizing risk and return characteristics of callable bonds and embedded bond call options, we respond to the regulator's call and, hopefully, contribute to educating investors about the properties of derivative positions implicit in their corporate bond portfolios.

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Appendix A Additional Tables and Charts

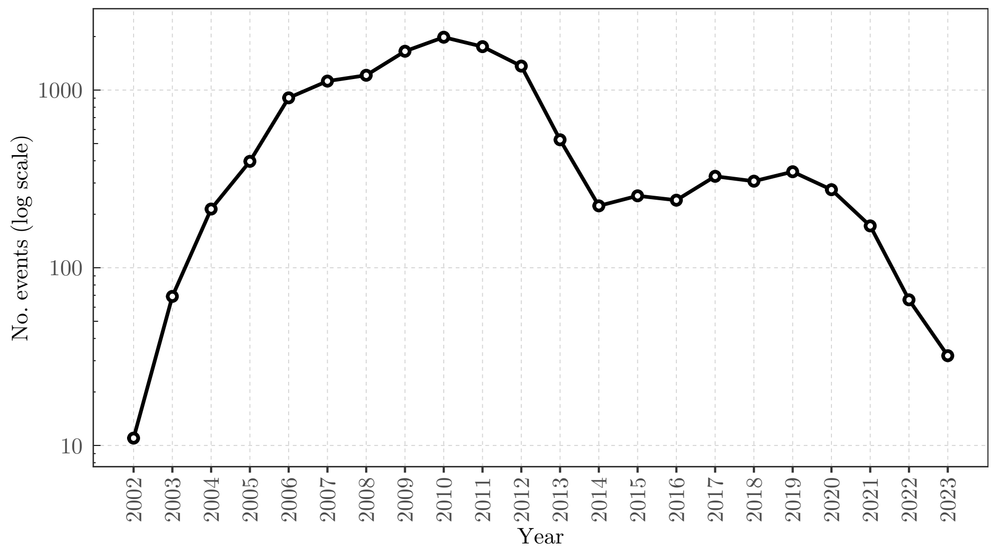

Figure A1: Sample size by calendar year
An event is a pre-scheduled notice date. The sample consists only of retail notes, all of which are discretely-callable at a fixed price pre-determined at the time of the note issuance.

Issuer name	No. bonds	MCap, $ bln
FORD MOTOR CO	566	30
BANK OF AMERICA CORP	367	131
DUPONT DE NEMOURS INC	299	46
PRUDENTIAL FINANCIAL INC	275	27
BANK OF NEW YORK MELLON CORP	268	35
GENERAL ELECTRIC CO	257	215
PROSPECT CAPITAL CORP	239	3
GENERAL MTRS ACCEP CORP	209	
CATERPILLAR INC	191	43
CIT GROUP INC	142	7

Table A1: Top-10 issuers of callable retail notes in the sample
'No. bonds' is the number of unique bond CUSIPs per issuer in the entire sample (2002–2023). Market capitalization is the average market value of the issuer's equity (from Compustat) before the bond (no-)call notice. If the issuer is not a listed company in the event window, its market cap is missing. The issuers' names are from the Mergent FISD dataset.

	Full smpl	Ex-GFC	Post-GFC
ITM × Not-called	2189	2144	1956
ITM × Called	851	849	665
ATM × Not-called	2231	2046	1808
ATM × Called	495	451	400
OTM × Not-called	7285	4826	2811
OTM × Called	413	284	242

Table A2: The number of events by option moneyness and call decision
This table presents the number of observations behind each category in Table 5.

	Dependent variable: $\mathbf{P}_i$ [Called]											
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Intercept	15.20***											
	(2.02)											
Intrinsic value (IV)	8.14***	6.81***	7.59***	7.46***	9.61***	9.37***	9.66***	8.76***	8.64***	6.74***	7.12***	5.81***
	(1.73)	(1.48)	(2.33)	(2.37)	(1.70)	(1.77)	(1.75)	(1.65)	(1.66)	(1.63)	(1.87)	(1.91)
Outstanding amount				0.08	1.02	1.17	0.87	1.63**	1.66**	1.62**	0.62	0.13
				(0.61)	(0.76)	(0.80)	(0.89)	(0.71)	(0.72)	(0.65)	(0.58)	(0.63)
Maturity				−1.61	−2.12	−1.30	−2.11	−1.20	−1.26	−2.59*	−1.10	−1.47
				(1.33)	(1.58)	(1.75)	(1.61)	(1.69)	(1.71)	(1.30)	(0.93)	(0.90)
Equity value					−3.81	−2.48	−3.41	7.30	7.10	4.22		
					(2.51)	(2.41)	(2.60)	(4.70)	(4.66)	(4.59)		
Book leverage					−3.41**		−3.18*	−8.33	−8.62	−3.86		
					(1.53)		(1.80)	(8.38)	(8.28)	(12.82)		
Market leverage						−5.18***						
						(1.70)						
Profit margin							1.25	4.45*	4.52*	4.10*		
							(1.74)	(2.48)	(2.48)	(2.19)		
Total payout ratio							−2.44**	−2.15*	−2.17*	−1.23		
							(1.09)	(1.13)	(1.15)	(0.98)		
Equity return (notice)									0.11	0.16		
									(0.38)	(0.42)		
Equity return (pre-notice)									−0.90	−1.25*		
									(0.66)	(0.65)		
Fiscal year-end (dummy)									4.14	5.98	7.28*	8.93*
									(4.88)	(5.18)	(4.03)	(4.74)
IV > IV @ prev. notice (dummy)										2.29**		0.23
										(1.11)		(0.79)
Year FE	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO	NO
Rating FE	NO	NO	YES	YES	YES	YES	YES	YES	YES	YES	NO	NO
Issuer FE	NO	NO	NO	NO	NO	NO	NO	YES	YES	YES	NO	NO
Issuer×Year FE	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES	YES
Observations	13,464	13,464	13,464	13,464	11,167	11,098	10,367	10,367	10,367	7,454	10,837	7,862
Adjusted R^2	0.06	0.15	0.17	0.17	0.20	0.21	0.19	0.26	0.26	0.26	0.47	0.45

Note: *p<0.1; **p<0.05; ***p<0.01

Table A3: Linear probability model for the call dummy

The table is analogous to Table 4 in the main text, but the underlying models are linear probability models here. The right-hand side variables (except for the dummies) are standardized. The sample period is 2002–2023. Standard errors are clustered by issuer.

	Dependent variable: XR^{ex10}								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\mathbb{1}^{\text{Surprise}} \times \mathbb{1}^{\text{ITM}}$	0.31	0.71**	0.70**	0.77**	0.79**	0.93**	1.05*	1.12**	1.11***
	(0.27)	(0.28)	(0.31)	(0.33)	(0.39)	(0.41)	(0.56)	(0.54)	(0.41)
$\mathbb{1}^{\text{Surprise}} \times \mathbb{1}^{\text{ATM}}$	0.11	0.15	0.14	0.23	0.12	0.20	1.04**	1.03**	0.58
	(0.29)	(0.27)	(0.27)	(0.26)	(0.28)	(0.27)	(0.41)	(0.44)	(0.38)
$\mathbb{1}^{\text{Surprise}} \times \mathbb{1}^{\text{OTM}}$	0.66	0.58	0.59	0.80	0.80	0.62	−0.31	0.28	0.11
	(0.48)	(0.55)	(0.56)	(0.52)	(0.50)	(0.51)	(0.59)	(0.51)	(0.66)
Equity return		0.18***	0.18***	0.20***	0.19***	0.19***			0.20***
		(0.03)	(0.03)	(0.02)	(0.02)	(0.02)			(0.03)
$\Delta ADNV$			0.002	0.02	0.02	0.02			0.03**
			(0.02)	(0.01)	(0.01)	(0.01)			(0.01)
$\mathbb{1}^{\text{ITM}}$	0.22	0.02	0.03						
	(0.13)	(0.12)	(0.15)						
$\mathbb{1}^{\text{ATM}}$	−0.02	0.07	0.07	0.05	0.20	0.16	−0.30	−0.15	−0.09
	(0.20)	(0.21)	(0.22)	(0.27)	(0.30)	(0.33)	(0.39)	(0.38)	(0.36)
$\mathbb{1}^{\text{OTM}}$	0.71**	0.38	0.38	0.24	0.25	0.27	1.11*	1.40**	0.37
	(0.27)	(0.26)	(0.27)	(0.28)	(0.36)	(0.40)	(0.62)	(0.60)	(0.48)
Bond controls	NO	NO	NO	YES	YES	YES	NO	YES	YES
Year FE	NO	NO	NO	NO	YES	YES	NO	NO	NO
Issuer FE	NO	NO	NO	NO	NO	YES	NO	NO	NO
Issuer×Year FE	NO	NO	NO	NO	NO	NO	YES	YES	YES
Observations	11,623	9,463	9,461	9,461	9,461	9,461	11,304	11,304	9,184
Adjusted R^2	0.0004	0.11	0.11	0.15	0.16	0.17	0.10	0.15	0.19

Note: *p<0.1; **p<0.05; ***p<0.01

Table A4: Excess return and call decision surprise (excl. transaction < \$10k) The underlying empirical model is equation (4). "Surprise" is a no-call for the ITM or ATM bonds and a call for the OTM bonds. Equity return is the percentage return on the issuer's publicly traded stock in the event window. $\Delta ADNV$ is the change in the average daily net volume, post-event to pre-event, in b.p. of the outstanding amount. Bond controls are the bond outstanding amount, maturity, coupon, and credit rating dummies. Models (7)–(9) are for issuer–years with at least ten events. Standard errors are clustered by issuer.

	Dependent variable: XR								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\mathbb{1}^{\text{Surprise}} \times \mathbb{1}^{\text{ITM}}$	0.53**	0.75**	0.71**	0.85***	1.09***	1.15***	1.37***	1.41***	1.30***
	(0.23)	(0.28)	(0.28)	(0.25)	(0.29)	(0.28)	(0.49)	(0.49)	(0.36)
$\mathbb{1}^{\text{Surprise}} \times \mathbb{1}^{\text{ATM}}$	0.23	0.16	0.13	0.26	0.29	0.33	0.96**	1.00**	0.57
	(0.32)	(0.27)	(0.28)	(0.22)	(0.20)	(0.24)	(0.47)	(0.49)	(0.45)
$\mathbb{1}^{\text{Surprise}} \times \mathbb{1}^{\text{OTM}}$	−0.10	0.09	0.12	0.03	0.003	0.08	−0.60	−0.60	−0.09
	(0.26)	(0.20)	(0.21)	(0.21)	(0.25)	(0.26)	(0.48)	(0.47)	(0.42)
Equity return		0.18***	0.18***	0.18***	0.18***	0.18***			0.18***
		(0.03)	(0.03)	(0.03)	(0.03)	(0.03)			(0.03)
$\Delta ADNV$			0.01	0.01	0.01	0.01			0.02**
			(0.01)	(0.01)	(0.01)	(0.01)			(0.01)
$\mathbb{1}^{\text{ITM}}$	0.06	−0.08	−0.05						
	(0.14)	(0.11)	(0.10)						
$\mathbb{1}^{\text{ATM}}$	−0.16	0.06	0.08	0.13	0.43*	0.40*	0.11	0.17	0.31
	(0.19)	(0.20)	(0.20)	(0.21)	(0.22)	(0.23)	(0.35)	(0.33)	(0.27)
$\mathbb{1}^{\text{OTM}}$	0.63**	0.08	0.07	0.25	0.54**	0.54**	1.36**	1.47**	0.69*
	(0.30)	(0.09)	(0.09)	(0.17)	(0.24)	(0.22)	(0.61)	(0.60)	(0.37)
Bond controls	NO	NO	NO	YES	YES	YES	NO	YES	YES
Year FE	NO	NO	NO	NO	YES	YES	NO	NO	NO
Issuer FE	NO	NO	NO	NO	NO	YES	NO	NO	NO
Issuer×Year FE	NO	NO	NO	NO	NO	NO	YES	YES	YES
Observations	7,870	6,886	6,883	6,883	6,883	6,883	7,673	7,673	6,697
Adjusted R^2	0.01	0.25	0.25	0.26	0.27	0.27	0.08	0.11	0.28
Note:	*p<0.1; **p<0.05; ***p<0.01								

Table A5: Excess return and call decision surprise (post-GFC sample)
The underlying empirical model is equation (4). "Surprise" is a no-call for the ITM or ATM bonds and a call for the OTM bonds. Equity return is the percentage return on the issuer's publicly traded stock in the event window. $\Delta ADNV$ is the change in the average daily net volume, post-event to pre-event, in b.p. of the outstanding amount. Bond controls are the bond outstanding amount, maturity, coupon, and credit rating dummies. Models (7)–(9) are for issuer–years with at least ten events. Standard errors are clustered by issuer.

	Dependent variable: xr								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\mathbb{1}^{\text{Surprise}} \times \mathbb{1}^{\text{ITM}}$	0.09**	0.12***	0.11***	0.14***	0.16***	0.16***	0.20***	0.20***	0.16***
	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.06)	(0.06)	(0.05)
$\mathbb{1}^{\text{Surprise}} \times \mathbb{1}^{\text{ATM}}$	0.11	0.06	0.06	0.09**	0.10**	0.10**	0.22***	0.23***	0.12*
	(0.07)	(0.05)	(0.05)	(0.04)	(0.04)	(0.05)	(0.08)	(0.07)	(0.06)
$\mathbb{1}^{\text{Surprise}} \times \mathbb{1}^{\text{OTM}}$	−0.05	0.02	0.03	−0.02	−0.02	−0.02	−0.11	−0.12	−0.03
	(0.10)	(0.10)	(0.10)	(0.07)	(0.07)	(0.07)	(0.10)	(0.08)	(0.08)
Equity return		0.03***	0.03***	0.02***	0.02***	0.02***			0.02***
		(0.003)	(0.003)	(0.003)	(0.003)	(0.003)			(0.005)
$\Delta ADNV$			0.002*	0.002*	0.002*	0.002			0.002**
			(0.001)	(0.001)	(0.001)	(0.001)			(0.001)
$\mathbb{1}^{\text{ITM}}$	0.01	−0.01	−0.01						
	(0.02)	(0.01)	(0.01)						
$\mathbb{1}^{\text{ATM}}$	−0.01	0.02	0.03	0.004	0.04	0.03	−0.005	0.01	0.02
	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)	(0.03)
$\mathbb{1}^{\text{OTM}}$	0.20**	0.08***	0.08***	0.09**	0.13***	0.13***	0.25***	0.30***	0.15***
	(0.08)	(0.02)	(0.02)	(0.04)	(0.04)	(0.04)	(0.09)	(0.09)	(0.05)
Bond controls	NO	NO	NO	YES	YES	YES	NO	YES	YES
Year FE	NO	NO	NO	NO	YES	YES	NO	NO	NO
Issuer FE	NO	NO	NO	NO	NO	YES	NO	NO	NO
Issuer×Year FE	NO	NO	NO	NO	NO	NO	YES	YES	YES
Observations	7,870	6,886	6,883	6,883	6,883	6,883	7,673	7,673	6,697
Adjusted R^2	0.01	0.21	0.21	0.24	0.24	0.25	0.09	0.16	0.26

Note: *p<0.1; **p<0.05; ***p<0.01

Table A6: Duration-adjusted spread return xr_i and call decision surprise (post-GFC sample)

The underlying empirical model is equation (4). The return measure is xr_i, which is XR_i divided by the pre-event bond duration. "Surprise" is a no-call for the ITM or ATM bonds and a call for the OTM bonds. Equity return is the percentage return on the issuer's publicly traded stock in the event window. $\Delta ADNV$ is the change in the average daily net volume, post-event to pre-event, in b.p. of the outstanding amount. Bond controls are the bond outstanding amount, maturity, coupon, and credit rating dummies. Models (7)–(9) are for issuer–years with at least ten events. Standard errors are clustered by issuer.

	Dependent variable: XRS^n								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\mathbb{1}^{\text{Surprise}} \times \mathbb{1}^{\text{ITM}}$	0.41	0.38	0.33	0.41	0.59**	0.71**	0.61**	0.65**	0.68*
	(0.29)	(0.27)	(0.27)	(0.30)	(0.26)	(0.29)	(0.26)	(0.30)	(0.35)
$\mathbb{1}^{\text{Surprise}} \times \mathbb{1}^{\text{ATM}}$	−0.04	0.01	−0.05	0.13	0.09	0.17	0.20	0.26	0.30
	(0.46)	(0.46)	(0.45)	(0.49)	(0.53)	(0.58)	(0.50)	(0.53)	(0.52)
$\mathbb{1}^{\text{Surprise}} \times \mathbb{1}^{\text{OTM}}$	−0.35	−0.40	−0.35	−0.43	−0.41	−0.33	−0.09	−0.12	−0.25
	(0.28)	(0.27)	(0.28)	(0.26)	(0.26)	(0.24)	(0.33)	(0.31)	(0.32)
Equity return		−0.03***	−0.03***	−0.03***	−0.03***	−0.03***			−0.04***
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)			(0.01)
$\Delta ADNV$			0.02***	0.02***	0.02***	0.02***			0.02***
			(0.01)	(0.01)	(0.01)	(0.01)			(0.01)
$\mathbb{1}^{\text{ITM}}$	0.07	0.09	0.14						
	(0.28)	(0.29)	(0.29)						
$\mathbb{1}^{\text{ATM}}$	0.29	0.24	0.29	0.01	0.26	0.37	0.13	0.17	0.20
	(0.35)	(0.34)	(0.34)	(0.40)	(0.37)	(0.42)	(0.38)	(0.40)	(0.42)
$\mathbb{1}^{\text{OTM}}$	0.08	0.15*	0.14*	−0.13	0.09	0.29	0.11	0.16	0.32
	(0.09)	(0.07)	(0.07)	(0.32)	(0.34)	(0.36)	(0.39)	(0.43)	(0.48)
Bond controls	NO	NO	NO	YES	YES	YES	NO	YES	YES
Year FE	NO	NO	NO	NO	YES	YES	NO	NO	NO
Issuer FE	NO	NO	NO	NO	NO	YES	NO	NO	NO
Issuer×Year FE	NO	NO	NO	NO	NO	NO	YES	YES	YES
Observations	3,370	3,308	3,307	3,307	3,307	3,307	3,341	3,341	3,278
Adjusted R^2	0.002	0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.04

Note: *p<0.1; **p<0.05; ***p<0.01

Table A7: Event return relative to a matched non-callable bond and call decision surprise (post-GFC sample)

The underlying empirical model is equation (4). The return measure is XRS_i^n, which is the difference in spread returns between a callable and a maturity-matched non-callable bond of the same issuer in the event window. "Surprise" is a no-call for the ITM or ATM bonds and a call for the OTM bonds. Equity return is the percentage return on the issuer's publicly traded stock in the event window. $\Delta ADNV$ is the change in the average daily net volume, post-event to pre-event, in b.p. of the outstanding amount. Bond controls are the bond outstanding amount, maturity, coupon, and credit rating dummies. Models (7)–(9) are for issuer–years with at least ten events. Standard errors are clustered by issuer.

	Dependent variable: XR_i					
	Investment-grade			High-yield		
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}^{\text{Surprise}} \times \mathbb{1}^{\text{ITM}}$	0.70**	0.78**	0.90**	−0.34	1.83*	2.12**
	(0.29)	(0.30)	(0.34)	(0.51)	(0.78)	(0.82)
$\mathbb{1}^{\text{Surprise}} \times \mathbb{1}^{\text{ATM}}$	0.18	0.14	0.21	−1.25**	0.69	1.04
	(0.21)	(0.22)	(0.24)	(0.44)	(0.92)	(0.75)
$\mathbb{1}^{\text{Surprise}} \times \mathbb{1}^{\text{OTM}}$	0.73	0.76	0.50	0.06	−1.62*	−1.54**
	(0.49)	(0.48)	(0.51)	(0.15)	(0.67)	(0.62)
Equity return	0.19***	0.18***	0.18***	0.23***	0.23***	0.23***
	(0.03)	(0.03)	(0.03)	(0.01)	(0.03)	(0.03)
$\Delta ADNV$	0.01	0.01	0.01	0.01	0.04	0.04
	(0.01)	(0.01)	(0.01)	(0.05)	(0.04)	(0.04)
$\mathbb{1}^{\text{ATM}}$	0.13	0.36	0.35	0.19	−0.20	−0.14
	(0.24)	(0.27)	(0.29)	(0.36)	(0.25)	(0.19)
$\mathbb{1}^{\text{OTM}}$	0.15	0.33	0.37	−0.38	−0.42	−0.18
	(0.19)	(0.29)	(0.28)	(0.55)	(1.46)	(1.32)
Bond controls	YES	YES	YES	YES	YES	YES
Year FE	NO	YES	YES	NO	YES	YES
Issuer FE	NO	NO	YES	NO	NO	YES
Observations	9,713	9,713	9,713	1,451	1,451	1,451
Adjusted R^2	0.15	0.16	0.16	0.23	0.28	0.28
Note:	*p<0.1; **p<0.05; ***p<0.01					

Table A8: Excess return (XR) attribution for IG and HY bonds separately (full sample)

The underlying empirical model is equation (4). The models presented here correspond to models (4)–(6) in Table 6. "Surprise" is a no-call for the ITM or ATM bonds and a call for the OTM bonds. Equity return is the percentage return on the issuer's publicly traded stock in the event window. $\Delta ADNV$ is the change in the average daily net volume, post-event to pre-event, in b.p. of the outstanding amount. Bond controls are the bond outstanding amount, maturity, coupon, and credit rating dummies. Standard errors are clustered by issuer.

	Dependent variable: XR_i					
	Non-financial			Financial		
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}^{\text{Surprise}} \times \mathbb{1}^{\text{ITM}}$	0.52*	0.82***	0.88***	1.20***	1.51***	1.64***
	(0.25)	(0.22)	(0.21)	(0.34)	(0.52)	(0.46)
$\mathbb{1}^{\text{Surprise}} \times \mathbb{1}^{\text{ATM}}$	0.25	0.26	0.27	0.42	0.49	0.53
	(0.41)	(0.34)	(0.36)	(0.29)	(0.31)	(0.39)
$\mathbb{1}^{\text{Surprise}} \times \mathbb{1}^{\text{OTM}}$	0.06	0.02	−0.01	−0.04	−0.08	0.02
	(0.15)	(0.18)	(0.18)	(0.33)	(0.42)	(0.47)
Equity return	0.13***	0.13***	0.13***	0.22***	0.22***	0.22***
	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
$\Delta ADNV$	0.02***	0.02***	0.02***	0.01	0.01	0.01
	(0.01)	(0.005)	(0.005)	(0.01)	(0.01)	(0.01)
$\mathbb{1}^{\text{ATM}}$	0.18	0.48	0.55	0.08	0.31	0.33
	(0.34)	(0.28)	(0.33)	(0.27)	(0.29)	(0.31)
$\mathbb{1}^{\text{OTM}}$	0.52	0.82*	0.93*	0.19	0.43	0.50
	(0.39)	(0.38)	(0.45)	(0.27)	(0.41)	(0.36)
Bond controls	YES	YES	YES	YES	YES	YES
Year FE	NO	YES	YES	NO	YES	YES
Issuer FE	NO	NO	YES	NO	NO	YES
Observations	3,495	3,495	3,495	3,384	3,384	3,384
Adjusted R^2	0.21	0.22	0.22	0.31	0.32	0.32
Note:	*p<0.1; **p<0.05; ***p<0.01					

Table A9: Excess return (XR) attribution for bonds issued by financial and non-financial firms separately (full sample)

The underlying empirical model is equation (4). The models presented here correspond to models (4)–(6) in Table 6. "Surprise" is a no-call for the ITM or ATM bonds and a call for the OTM bonds. Equity return is the percentage return on the issuer's publicly traded stock in the event window. $\Delta ADNV$ is the change in the average daily net volume, post-event to pre-event, in b.p. of the outstanding amount. Bond controls are the bond outstanding amount, maturity, coupon, and credit rating dummies. Standard errors are clustered by issuer.