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Corporate Bond Purchase Program and Corporate Debt Issuance: Evidence from Japanese Corporate Bond Marketing News

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Abstract

This study empirically investigates the effects of the corporate bond purchase program conducted by the Bank of Japan (BOJ) on bond issuance and issuers. By applying a large language model to market news on corporate bond issuance, we identify individual bond issues that attract demand from investors intending to resell them to the BOJ through its purchase program. Using this indicator of demand, we find that the credit spreads of such bonds are more than 20% lower than those without it, and their issuance sizes are approximately 15% larger. Additionally, the effects on corporate bonds with investor demand to utilize the BOJ program are greater than those on bonds that are merely eligible for it. Finally, we show that firms leveraging the BOJ's program to increase bond issuance allocate the raised funds to capital investment while reducing bank borrowing.

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1 Introduction

Since the 2000s, the Bank of Japan (BOJ) has implemented various unconventional monetary policies, with the corporate bond purchase program emerging as a key measure in the primary corporate bond market, particularly during the COVID-19 pandemic. Regarding market size, corporate bond issuance in Japan has doubled over the past decade, while trading volume has declined by more than half. Although low yields for short-term corporate bonds would weaken investors' demand, their issuance surged in 2020 (Figure 1) under the BOJ's expanded purchase program, which increased purchase amounts and relaxed eligibility conditions. During this period, media reports frequently highlighted the program's influence on corporate debt issuance, noting strong investor demand for reselling bonds to the BOJ through its market operations, a strategy commonly referred to as the "BOJ trade."[1] The BOJ trade refers to a strategy in which financial institutions profit by purchasing newly issued bonds and reselling them to the BOJ at a higher price within a short period. Despite its recognized market impact, research on the corporate bond purchase program and the BOJ trade remains limited partly due to a lack of detailed data.

This study leverages professional corporate debt marketing news to address the lack of granular information on the BOJ's corporate bond purchases.[2] We take advantage of professional corporate debt marketing news to directly identify BOJ trade demand for individual bond issues and measure such demand effect among eligible bonds. Specifically, we utilize professional debt marketing news compiled by Capital Eye, integrating a large language model (LLM), Google Gemini, to analyze investor demand and the formation of credit spreads during the marketing process. By matching this information with data on corporate bond issuances in Japan, we construct a novel dataset incorporating issuing conditions and extract marketing process details.

A major challenge in studying the BOJ's corporate bond purchases lies in identifying the specific corporate bonds it has purchased. The BOJ does not disclose cumulative purchase amounts by issuer and only provides general eligibility conditions, such as credit rating categories and target maturities. In addition, the BOJ sets issuer-specific purchase limits, both in terms of the total amount and the ratio of the purchased amount to the total amount issued by each issuer. The lack of disclosure prevents the direct identification of issuers whose bonds have reached these limits.

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[1]For example, see Tomisawa and Hazama (2019) on Bloomberg and "Corporate bond market: 'Bank of Japan' trade rampant." April 8, 2023, on NIKKEI News.

[2]The BOJ only discloses total purchase amounts under the program.

Therefore, classifying all eligible bonds as BOJ-purchased would lead to imprecise estimates of the impact. Furthermore, the BOJ's eligibility conditions for issuer credit quality covered virtually all issuers in the Japanese primary market, particularly during the pandemic. Given the BOJ's policy settings, a difference-in-differences approach based on eligibility conditions—used in nearly all previous studies, including Galema and Lugo (2021)—is not appropriate for examining the BOJ's program.[3]

To address this challenge, we extract information disseminated among market participants from market news. Market participants can infer which bonds have reached the limit during the operation process, as illustrated in Figure 2. When bidding in the BOJ's operations, bidders indicate which bonds they wish to sell, in what amounts, and at what prices. If a specific bond has reached the issuer's purchase limit, the BOJ rejects the bid for the bond.[4] Therefore, whenever their bids cause the total purchase amount to exceed the limit, bidders can infer that the purchase limit for that issuer has been reached. By collecting such information, the news reports whether investors participating in BOJ operations buy specific bonds for resale among the eligible bonds. By directly identifying corporate bonds associated with investors' resale intentions, we examine whether BOJ market operations influence bond pricing and create spillover effects on other bonds.

In addition, we calculate the range of credit spreads offered to investors during the marketing process using market news, to quantify bond-level demand uncertainty. When issuing corporate bonds, underwriters undertake marketing efforts to assess investor demand and set issuance conditions, including for price range and volume. As shown in Figure 3, during the marketing process of a corporate bond offering, the lead underwriter narrows price ranges down to converge on the final price. Previous literature suggests that a wider range of launch spreads implies a higher uncertainty of investors' demand. We use the range of spreads to control uncertainty.[5]

Using the BOJ trade indicator and the range of launch spreads, we obtain the following findings. First, bonds targeted for BOJ trade exhibit significantly lower launch spreads (by over 20%) and larger issuance volumes (by 15–20%). These effects remain significant after controlling for bond maturity, issuer fixed effects, and time effects that account for other unconventional monetary policy shocks. We also show that the finding is robust by using matching, an alternative approach,

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[3]See section 2.2 for a detailed literature review.

[4]For example, in another case where the BOJ receives multiple bids at the same price and accepting all would push total purchases beyond the limit, the BOJ purchases a pro rata amount from each bidder within the limit.

[5]See Takahashi and Takaoka (2025).

and a placebo test. Second, these effects on corporate bonds with investor demand to utilize the BOJ program are greater than those on bonds that are merely eligible for the program. This result indirectly shows evidence for the validity of the BOJ trade indicator based on professional market news. Additionally, A- or BBB-rated bonds linked to the BOJ trade have spreads that are over 30% lower than non-BOJ trade bonds in the same rating categories, suggesting that the purchase program was particularly effective for relatively lower-rated bonds.[6] Third, we do not find a strong spillover effect of the intensifying BOJ purchase on non-eligible bonds. Rather, we find crowding out effects on ineligible bonds for launch spreads. Finally, using instrumental variable regression, we analyze the real effects of the BOJ's corporate bond purchase program on firm behavior. We find that firms with increasing issuance of corporate bonds due to the BOJ operation shortened the average maturity of debts. This is because firms increase the issuance of short-term bonds as they are eligible for the BOJ operation. In addition, we find that firms increasing bond issuance due to the program also expand capital investment. However, these firms reduce bank borrowing, suggesting that they use proceeds from bond issuance to repay loans.

This study contributes to research on unconventional monetary policy and its effects on financial markets in three key ways. First, by using an identification strategy based on market news, we estimate the program's impact more precisely than approaches that rely solely on eligibility criteria in Tsujimoto (2021) and Linh (2024). As discussed above, not all eligible bonds are purchased by the BOJ due to issuer-specific limits. In addition, in a low-interest-rate environment, corporate bonds with extremely low yields attract less interest from search-for-yield investors, even though they are eligible for the BOJ's operations. Research on the European CSPP, such as Galema and Lugo (2021), has examined the differential direct effect on the financing decisions of targeted firms versus eligible but not (yet) targeted firms. In addition to examining the effect on firms' debt financing, similar to Galema and Lugo (2021), we investigate the impact on firms' capital investment and find it significant.

Second, we control for uncertainty in the primary corporate bond market using a novel measure of market uncertainty. We demonstrate that the range of marketing spreads during the marketing process reflects bond-level demand uncertainty, a key factor in bond pricing. While previous studies, such as Boyarchenko et al. (2021), propose various uncertainty measures for the secondary market, few (e.g. Wang (2021)) have addressed uncertainty in the primary market.

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[6]In Japan, there is no high-yield bond market.

Finally, using the BOJ operation indicator as an instrument, we show evidence for significant effects on firms' real activities. Aligning with previous studies, among others, for example, De Santis and Zaghini (2021) for ECB CSPP and Darmouni and Siani (2025) for the 2020 Federal Reserve program, the results highlight the substitution effect of the policy on bank loans; however, no significant effect on cash holding is found. While prior studies have relied on eligibility conditions or used event study analyses focusing on the announcement effect, we use market information reflected in news articles about demand for the BOJ operation, focusing instead on the flow effect.

We perform several robustness tests, reported in section 4.6. Specifically, we address endogeneity concerns that could be due, for example, to the confounding factors that drive a spurious relationship between the demand for BOJ trade and corporate bond launch spread/issue amount, using an alternative measure for policy intervention and alternative specifications. Furthermore, we conduct a placebo test using the sample before the introduction of the program. All these robustness tests confirm our findings.

The remainder of this paper is organized as follows: Section 2 presents an institutional background of the corporate bond purchase program, followed by the literature review and hypotheses. Section 3 describes the data and sample construction process. Section 4 presents the empirical results. Section 5 concludes the paper.

2   Institutional background of the corporate bond purchase program and hypotheses development

2.1   Corporate bond purchase program

The BOJ implemented various unconventional monetary policy measures from the late 1990s to the early 2020s, compared with other central banks in developed countries. These measures include the zero-interest rate policy, forward guidance, QE, Quantitative and Qualitative Monetary Easing (QQE), the yield curve control (YCC) policy, and the negative interest rate policy. Among them, the BOJ engaged in outright purchases of corporate financing instruments with a residual maturity of up to one year, with a purchase limit of up to 50 billion yen for each issuer, to facilitate corporate financing during the Global Financial Crisis in 2009. Eligible corporate bonds were initially limited to those rated A or higher. Moreover, the BOJ set a lower yield limit when purchasing corporate bonds. As eligible bonds did not include the riskier ones that the financial institutions

were willing to sell through operation, the bid-to-cover ratio was low, as shown in the upper panel of Figure 4.[7]

In October 2010, the BOJ implemented the so-called comprehensive monetary easing policy and then decided to relax the eligibility criteria for bond purchases by including BBB-rated corporate bonds, aiming to reduce the risk premium. In April 2013, the BOJ introduced QQE and increased both the amount and the maturity of its purchases of long-term government bonds (see, for example, Bank of Japan (2016)). Additionally, the BOJ announced the establishment of the Outright Purchases of CP and Corporate Bonds program in alignment with the introduction of QQE. Table 1 presents the history of major modifications to corporate bonds eligible for market operations.

In response to the COVID-19 pandemic, the BOJ expanded the purchase amounts and relaxed the conditions of corporate bonds to be purchased. It increased the longest maturity from 3 years to 5 years and the maximum purchase amount per issuer from 100 to 300 billion JPY. The upper panel of Figure 4 plots the bid-to-cover ratio, demonstrating that investors were willing to sell their corporate bonds to the BOJ when the bond yields were considerably lower from late 2016 to 2023. Investors bought corporate bonds with target maturities even if their yields were close to zero because the BOJ purchased them at even lower yields, as shown in the lower panel of Figure 4. In 2020, the amount of all newly issued corporate bonds with a maturity of 5 years or less was 7000 billion yen, and the BOJ purchased more than 4000 billion yen of corporate bonds, as shown in Figure 5. Figure 6 indicates that the expansion of the corporate bond purchase program appeared to provoke the BOJ trade. Specifically, the amounts of competitive bids sharply surged soon after the announcement of the expansion of the corporate bond purchase program on April 27, 2020. As the cutoff rate in the outright purchases of corporate bonds was approximately zero or sometimes negative, the investor could earn a profit by reselling bonds to the BOJ through its market operations at a higher price within a short period.

The eligibility conditions for the corporate bond purchase operation have subsequently tightened, and in March 2024, the BOJ decided to gradually reduce the amount of purchases of corporate bonds and discontinue the purchases in approximately one year. Then, the last auction was conducted in January 2025.

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[7]For example, see "The BOJ governor does not consider easing conditions on purchasing corporate bonds." April 14, 2009, on NIKKEI evening edition.

2.2   Literature review and hypotheses development

This study primarily addresses four strands of literature. The first focuses on the effect of unconventional monetary policy on corporate bond credit spread and issue amounts. Numerous studies have reported a significant decrease in corporate bond credit spreads across various markets because of the ECB's quantitative easing (QE), particularly through its CSPP (Abidi and Miquel-Flores (2018); Li et al. (2021); Rischen and Theissen (2021); Todorov (2020); Pegoraro and Montagna (2025)). Following the announcement of the CSPP, Todorov (2020) demonstrated that the yields of eligible bonds in the secondary market declined more substantially than those of non-eligible bonds, and Zaghini (2019) showed that corporate spreads in the primary market also witnessed a reduction of 30 basis points. Additionally, Abidi and Miquel-Flores (2018) and Li et al. (2021) provide evidence of a smaller but substantial and statistically significant impact of the CSPP on credit spreads. De Santis and Zaghini (2021) investigated the effect of the CSPP on corporate bond issuance and found that corporate bond issuances by eligible firms for the CSPP increased. Collectively, this evidence informs the following hypothesis on corporate bond offerings, specifically regarding the direct *flow* effects.

H1: The launch spread of corporate bonds linked to the BOJ trade is lower and their issue size is larger than those of bonds with no link to the BOJ trade.

Marketing news information allows us to identify a specific bond issuance on which the BOJ's program is having an effect among the eligible bonds; we test this hypothesis by examining the direct effect of the BOJ's corporate bond purchase program on individual corporate bond offerings. This information extraction relates to the strand of research utilizing news and social media to extract information regarding people's views on the economy and monetary policies. Among others, Meinusch et al. (2017) exploited data from Twitter to extract information regarding people's beliefs about the timing of their exit from QE and showed that belief in social media significantly affects interest and exchange rates. Additionally, Fisher et al. (2022) constructed macroeconomic attention indices using news articles and found that greater attention to macroeconomic news is associated with higher stock returns on the announcement days of macroeconomic variables. We contribute to this literature by exploiting market news specializing in the corporate bond market. This is particularly relevant given the simultaneous implementation of different unconventional policies by the BOJ, which makes it difficult to disentangle each effect.

The third strand of literature focuses on price formation of the corporate bond offering during the pre-launch marketing phase. As most studies have focused on price formation in the equity initial public offering (IPO), studies on corporate bond offerings are limited because of a lack of data about the initial bond price. Moreover, analysis of price formation in the corporate bond marketing process is scarce. Recent studies have used novel data, elucidating pricing and demand in the corporate bond offering process. Wang (2021) studied pricing formation using data on initial price talk (IPT) from Bloomberg, examining the price formation of corporate bonds issued during 2016-2018 and providing evidence in favor of bookbuilding theories. Hotchkiss et al. (2021) and Bessembinder et al. (2022) reported that the underwriter responds and adjusts to investor demand (uncertainty) in the corporate bond offering process. We focus on the range of corporate bond spreads offered during the marketing process over a relatively extended sample period.

Additionally, marketing news includes information on planned corporate bond issuances that are expected to come to market in the near future, as well as the presence or absence of investor demand for BOJ operations. Hence, we test whether the effects of the corporate purchase program are not limited to the eligible bonds.

H2a: Spillover effect: The launch spread of long-term bonds ineligible for the BOJ operation decreased.

H2b: Crowding-out effect: The launch spread of ineligible bonds for the BOJ operation increased.

Furthermore, the policy intervention aims to support the corporate bond market and also bolster the economy, resulting in real effects. De Santis and Zaghini (2021) found that the CSPP allowed eligible firms to repurchase their own stocks, hold cash, and invest in marketable and equity securities. Boneva et al. (2022) reported improvements in the market liquidity of purchased bonds in the Bank of England's 2016-2017 Corporate Bond Purchase Scheme.

Few studies have investigated the effects of the BOJ's corporate bond purchase program. Tsujimoto (2021) is one such study, focusing on the change in the program during the COVID-19 pandemic. It revealed that the maturity of new bond issuances by firms shifted in response to the BOJ's policy change. Similarly, Linh (2024) examined the effect of the BOJ's exchange-traded fund and corporate bond purchase program and showed that firms whose corporate bonds were eligible for the corporate bond program issued more bonds and had a higher leverage ratio than non-eligible firms. We extend these studies using market news and by focusing on the effect of

corporate bond programs on investor demand. We illustrate the magnitude of the policy effect on the primary market for corporate bonds.

Regarding the Fed's corporate bond purchase program, particularly during the COVID-19 pandemic, numerous researchers focused on its impact on liquidity in the corporate bond market (Boyarchenko et al. (2022); Falato et al. (2021); Gilchrist et al. (2024); Haddad et al. (2021); Kargar et al. (2021); Nozawa and Qiu (2021); O'Hara and Zhou (2021)). Additionally, other studies have investigated its effects on firms' funding strategies (Boyarchenko et al. (2022); Acharya and Steffen (2020); Halling et al. (2020); Becker and Benmelech (2021); Pettenuzzo et al. (2021); Darmouni and Siani (2025)). However, the impact of the Fed's program was not as pronounced as that of the ECB's program. For example, Halling et al. (2020) found that firms increased their corporate bond maturities despite the Fed's program targeting shorter maturities, indicating that firms prioritized avoiding rollover risks. Boyarchenko et al. (2022) did not find any indication that companies issued bonds with shorter maturities because of the Fed's program. Regarding the weak real investment response, Darmouni and Siani (2025) argue that targeted firms have a low (shadow) value of additional liquidity, as they might not be among the most financially constrained. The third hypothesis arises from research testing the real effect of central bank bond market interventions.

H3: Bond market intervention has effects on real activities of firms with the funds; that is, firms increase their real investment.

3 Data

3.1 Data on corporate bond issuance

To comprehensively analyze the data, we combine information from various sources. Specifically, we collect issue-level corporate bond data from the London Stock Exchange Group (LSEG) (formerly, Thomson Reuters) Eikon Investment Banking database. Our dataset encompasses corporate bonds issued by entities based in Japan and denominated in JPY, spanning from January 1, 2005, to December 31, 2023. We exclude Fiscal Investment and Loan Program (FILP) agency bonds that the central government guarantees. Following prior studies, we limit the sample to only senior issues with fixed coupon schedules. This dataset provides detailed information on individual bond issuances, including issuer information, transaction type, launch spread, issue amounts, maturity dates, issue dates, and credit ratings.

3.2 Financial statement data

To enhance our analysis, we merge the corporate bond issuance dataset with issuing firms' financial data (e.g., total assets). Financial indicators for the accounting year immediately preceding each corporate bond issuance are sourced from OSIRIS.

3.3 Corporate debt maturity structure data

To calculate the ratio of debt maturing in 2 and 3 years over total debt and that of debt maturing in 2, 3, 4, and 5 years over total debt for each issuer, data on long-term loans payable and long-term debt maturing in one year, two years, and up to six years for the accounting year immediately preceding each corporate bond issuance are respectively retrieved from LSEG.

3.4 Data on equity and government bond market

We incorporate variables related to a measure of the market's expectation of volatility. The Japanese Government Bond (JGB) market variables include JGB yield and the JGB VIX, the implied volatility of JGBs using options on 10-year JGB futures. JGB yield is from LSEG, and JGB VIX is from the Japan Exchange Group website. Nikkei Volatility, calculated by using prices of Nikkei Stock Average (Nikkei 225) futures and Nikkei 225 options, indicates the expected degree of fluctuation of the Nikkei 225. The data are from LSEG.

Table 2 presents the descriptive statistics for the variables used in the estimations.

3.5 Extraction of information from corporate bond marketing news

To extract information on investor demand and the perceived impact of the BOJ's corporate bond purchase program on corporate bond issues during the marketing process, we use the market review on new bond offerings compiled by Capital Eye. Capital Eye is a news provider specializing in capital markets, including corporate bonds and equity markets.

Capital Eye provides news on market conditions and the views of investors and intermediaries, such as securities companies, for market participants.[8] They also cover market reviews of deals for new offerings of corporate bonds by interviewing people in securities companies and investors.

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[8]Rating agencies, government institutions, issuers, banks, and all main securities companies are subscribed to the news service (29 securities companies).

Among news provided by Capital Eye, we utilize a series of reviews on deals for new issuing bonds, called the "Anken Review," which reports comprehensive summaries of the marketing process, evaluation of the issuance conditions by market participants, and strength of demands of investors, starting with the condition of the corporate bond market before the "sounding" process. In the reviews, the impact of the BOJ's monetary policy is frequently mentioned by citing comments from market participants, including securities companies and institutional investors. For example, on November 17, 2023, Capital Eye published a review of the issuance of Nichirei's 3-year corporate bond and illustrated the strength of demand by quoting a salesperson at UFJ Morgan Stanley as follows, "Nichirei's corporate bond successfully incorporated the demand of investors who are willing to utilize the BOJ's operation."[9]

We utilize a series of deal reviews to create a dummy variable indicating investor demand aimed at leveraging the BOJ's corporate bond purchase program. However, given the extensive number of "Anken reviews (deal reviews)," exceeding 4,000, determining whether each review mentions investor demands anticipating the utilization of the BOJ's program requires advanced language analysis. To address this aspect, we employ Gemini Pro 1.0, a language model developed by Google, known for its performance across various domains, comparable to ChatGPT 4, one of the most prominent LLMs; for example, see Fu et al. (2023).

We employ the Gemini API and prompt it to extract details regarding investors' demand and issuance conditions during marketing (see Code Listing in Appendix A for prompt specifics). Our focal variable is the BOJ operation dummy, I(BOJ operation). We instruct Gemini to search for terms synonymous with "the BOJ's operation" and "BOJ's purchase." If an article contains at least one relevant term, the dummy variable is set to one; otherwise, it is set to zero. We provide Gemini with six examples of a prompt-response pair to increase extraction accuracy. Following the extraction process with Gemini, we manually verified the accuracy of information retrieval by reviewing sampled articles. Our findings indicate that Gemini adeptly captures relevant information from news texts. Figure 7 shows the share of corporate bond issuance with the dummy equal to one in the total issuance in each month. The share peaked at more than 40% in May 2020 when the BOJ expanded the corporate bond purchase program to provide liquidity to the market after the onset of the pandemic.

We also extract the range of spreads in the marketing process. Underwriters undertook mar-

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[9]The original news was published in Japanese and translated by the authors.

keting efforts before selling corporate bonds to determine conditions such as the issuing amount and interest rate. They began with a sounding/hearing process and carried out marketing multiple times to finalize the issuing conditions. The underwriters started with pricing ranges and gradually narrowed them down to converge on the final price. The deal review provides detailed reports on the same. We collected this range in the marketing process from the text in the news article using Gemini Pro 1.0.[10] Takahashi and Takaoka (2025) detail the variable construction and economic implications.

4 Effects of the BOJ operation

4.1 Empirical model

We analyze the effect of the BOJ trade demand and the uncertainty of investor demand on launch spread and issue amount by utilizing the *BOJ operation* dummy, controlling for investor demand uncertainty, reflecting the high-low range of marketing spreads in the marketing process (Table 3). First, we focus on the intensive margin; our baseline estimation is based on the following specification.

$$
\begin{aligned}
Y_{i,j,t} = \alpha_j + \omega_t + \beta_0 I(\text{BOJ operation})_{ijt} + \beta_1 \text{Marketing range}_{ijt} \\
+ \boldsymbol{\gamma}' \mathbf{Controls}_{i,j,t} + \upsilon_{i,j,t},
\end{aligned}
\tag{1}
$$

where $Y_{i,j,t}$ denotes the launch spread or issue amount of the individual corporate bond issuance i of firm j at time t. The dependent variable is the logarithm of the launch spread in basis points or issue size in millions of JPY. The vector of variables **Controls** contains the following sets of variables: (i) the issuing firm's credit rating variables, (ii) the issuing firm's financial indicators, and (iii) variables related to bond characteristics. The issuing firm's credit rating variables are 0-1 dummy variables. For example, the *AA rating* takes the value unity if the borrower's rating is AA+, AA, or AA-, and zero otherwise. In (ii), the vector of a firm's financial indicators includes *sales*, *net income*, and *EBITDA*.[11] Additionally, to control for corporate bond characteristics, we include the *maturity* of the corporate bond and the green bond dummy I(green bond) to absorb the demand

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[10]For example, regarding the issuance of a 5-year bond by Furukawa Kikai Kinzoku, on December 15th, 2023, "With an issuance amount of approximately 5 billion yen, the first round of sounding was conducted on the 7th and 8th, indicating a guidance of approximately 1.2% to 1.3%. Considering the 5-year BBB-rated corporate bonds, the TRE Holdings bond (BBB: R&I) with the same rating was launched at 1.50% at the end of August."

[11]We include many financial indicators in addition to these three variables. Considering the availability of and multicollinearity between the variables, we restrict their inclusion.

for green bonds, which takes the value unity if the corporate bond issuance i is a green bond and zero otherwise. We include firm fixed effects, represented by α_j, to account for unobserved issuer heterogeneity at the firm level, and time fixed effects, represented by ω_t. Standard errors are clustered at the issuer and time (month) level.

In this section, we first report the results using the baseline specification of Equation 1, where the variables of interest are the BOJ trade variable and the marketing range. We then examine the spillover effects of the corporate bond purchase program on the corporate bonds that are not targeted by the BOJ's policy. Finally, we investigate the effects of the corporate bond purchase program on corporate debt maturity structure, investment, bank loans, and cash holdings.

4.2 Baseline results

4.2.1 Identification of corporate bonds linked to the BOJ operation

We verify the accuracy of information retrieval on *BOJ Operation* dummy if the article reports the investors' demand backed by the BOJ's purchase program by human reading and the marketing range variable by randomly reviewing sampled articles. We then conduct the following validation exercises to confirm that our variable is a reliable measure.

Extracting investor demand information from news text sources improves the identification of corporate bond offerings linked to the operation relative to an alternative approach using only the conditions of eligible bond maturity and credit rating category. We make a dummy variable, *I(Eligible)*, taking the value unity if the corporate bond satisfies the conditions of the eligible corporate bond's credit rating and remaining maturity in Table 1. As the BOJ does not disclose the corporate bonds purchased through the operation, the individual issuer's balance within the maximum purchase amount is not observed in Table 1. With the internal information that participants in the operation have regarding which and how much bond they sold or could not sell to the BOJ, we identify which corporate bonds the investor buys for the BOJ trade. *I(BOJ operation)* takes the value unity if the news article mentions the demand from investors willing to utilize the BOJ purchase program.

We show the validity of the BOJ operation dummy by examining the impact on the launch spread and issue amount. We run the following panel regression.

$$Y_{i,j,t} = \alpha_j + \omega_t + \beta_0 I(\text{BOJ operation})_{ijt} + \beta_1 I(\text{Eligible}_{ijt}) + \boldsymbol{\gamma}'\textbf{Market Controls}_{i,j,t}$$
$$+ \upsilon_{i,j,t}, \tag{2}$$

where $Y_{i,j,t}$ denotes the launch spread or issue amount of the individual corporate bond issuance i of firm j at time t. The dependent variable is the logarithm of the launch spread in basis points or issue size in millions of JPY. The indicator I(BOJ operation) takes the value unity if the news article for corporate bond issuance i mentions the demand of investors who are willing to utilize the BOJ purchase program and zero otherwise. I(Eligible) takes the value of one if the issue is eligible for the BOJ operation and zero otherwise. The market control variables include JGB VIX and Nikkei 225 VI. We include firm fixed effects, represented by α_j, to account for unobserved issuer heterogeneity at the firm level, and time fixed effects, represented by ω_t. Standard errors are clustered at the issuer and time (month) level.

We compare the effect of *I(Eligible)* to that of *I(BOJ operation)* on credit spreads and bond issue amounts and report the results in Table 4. Results in Columns 1, 2, 4, and 5 show that the launch spreads (issue amounts) for both eligible corporate bonds and those linked to the BOJ operation are significantly lower (larger). Results in Columns 3 and 6 indicate the significant and incremental explanatory power of *I(Eligible)* $\times$ *I(BOJ operation)*, which supports Hypothesis 1. They show that if the *Eligible* bond is utilized in the BOJ trade, the impact is doubled, suggesting that our *I(BOJ operation)* is a useful indicator to identify the corporate bonds that the BOJ purchases.

4.2.2   Impacts on launch spread

First, we investigated the impact of the BOJ's corporate bond purchase program and marketing spread on the launch spread utilizing news information representing demand driven by the BOJ trade, I(BOJ operation). Table 5 presents the estimation outcomes for the baseline model, with the logarithm of the launch spreads serving as the dependent variable. Across specifications, the dummy variable I(BOJ operation) exhibits significantly negative coefficients, indicating a significant reduction effect. Moreover, the observed impact holds economic significance, indicating that when investor demand is linked to intentions of resale to the BOJ, the launch spread experiences a 20% reduction compared with deals lacking such demand in the market review.

This finding underscores how the BOJ's policy effectively stimulates investor demand by facilitating corporate bond purchases in their purchase program. The green bond dummy does not yield a significant impact on the launch spread; that is, there is no greenium, although it does not constitute the primary focus of this study. The wider *Marketing range*, which is a proxy for the

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uncertainty of investor demand, increases the launch spread. The coefficients of the other control variables show anticipated signs: higher credit ratings correlate with lower spreads, although the distinction between AAA and AA ratings lacks statistical significance; bonds with longer maturities tend to exhibit higher spreads owing to term premiums; and bonds issued by firms with higher net income generally demonstrate lower spreads.

While these findings underscore the significant impact of the corporate bond purchase program, we further examine how and whether the credit risk is priced in the launch spread of bonds for the BOJ trade. The results in Columns 1 and 2 of Table 6, whose observations are restricted to the bonds with I(BOJ operation)=1, indicate that the maturity of the bond is a significant factor in the launch spread of corporate bonds for the BOJ trade, but the credit rating dummies are not significant.[12]

This result suggests that the credit quality would not be significantly priced in bonds for the BOJ trade. The investors need not worry about the default risk of the issuer because they resell corporate bonds to the BOJ through its market operations within a short period. Columns 3 and 4 in Table 6 present results suggesting that the reduction in launch spreads of corporate bonds due to the BOJ trade in the upper medium grade (A rating) and lower medium grade (BBB rating) is significant. Their spreads are lower by 30% than those for deals lacking such demand in the same credit rating group. The reduction in spread caused by the BOJ trade is not statistically significant in the high-grade credit rating AA or higher categories, partly because credit spreads for those categories are sufficiently low. By contrast, the degree of impact of the corporate bond purchase program is substantial for A- and BBB-rated corporate bond spreads. These results are not surprising because the BOJ does not price individual corporate bonds through operation and buys corporate bonds with high rates (low price).

4.2.3 Impact on issue amounts

We analyze the BOJ corporate bond purchase program and issuance amount. The results in Table 7 exhibit significantly positive coefficients of I(BOJ operation), indicating that the issuance amount of corporate bonds linked to demand for the BOJ trade tends to be larger. This impact is economically significant, with investors' intentions to utilize the operation increasing by 15-20%.

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[12]The estimation specifications in this table do not include the variable, Marketing range, to increase the sample size.

This evidence suggests that the BOJ's purchasing operation significantly influences the issuing behavior of corporate bonds by altering investors' demand curves. Given the results in Tables 5 and 6 that show the significantly low launch spread of corporate bonds linked to the demand for BOJ trade, the investor demand for such corporate bonds is driven by the profits earned by reselling to the BOJ through market operations.

Marketing range does not affect the issue amount of the bond. Thus, the uncertainty of investor demand is adjusted through pricing as in Table 5 but not through the issue size for intensive margins. The coefficients of the other control variables show that the issue amount is smaller for the longer maturity; the issue amount of the prime credit quality bond is significantly larger than that of the other credit quality categories.

The findings reported thus far confirm the lower (larger) launch spread (issue size) for corporate bonds that are linked to the BOJ trade compared with the bonds lacking such demand. Additionally, a wider market range causes higher launch spreads, but it does not affect the issue size.

4.3 Spillover effects of the corporate bond purchase program

We demonstrated that corporate bonds that are linked to the BOJ trade benefited from the lower launch spread and larger issue amount compared with corporate bonds lacking such demand. This subsection clarifies the differential effects of the BOJ trade; for example, Figure 8 shows the time-series corporate bonds issue amounts of eligible corporate bonds and BOJ trade demand, indicating the large variation over time.

The BOJ modified the conditions of eligible bonds for the corporate bond purchase program as in Table 1. Thus, the expansion and shrinkage of eligible bonds have differential effects on the launch spreads. For example, if investors see a decline in the corporate bond yield and seek corporate bonds with a higher yield, the expansion in the BOJ corporate bond purchase could cause a decline in the spreads of corporate bonds that do not meet the conditions for the BOJ purchase program. If investors increase demand for the corporate bonds that are eligible for the program and decrease investment in ineligible bonds, the spreads of ineligible corporate bonds increase.

To examine this issue, we include the triple interaction effect of the BOJ trade demand dummy, the maturity dummy for the proxy of eligibility, and the cross-sectional average of the BOJ trade dummy. The average of the BOJ trade dummy indicates the overall intensity of investor demand for BOJ operations in the market. In the subsequent specification, coefficients of the triple interaction

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of interest represent the spillover effects:

$$
\begin{aligned}
\log(\text{Launch spread})_{i,j,t} = {} & \alpha_j + \omega_{k_j,y} + \beta_0 I(\text{BOJ operation})_{ijt} + \beta_1 \text{Marketing range}_{ijt} \\
& + \beta_2 \text{Average Operation}_{t-1} + \beta_3 I(\text{BOJ operation})_{ijt} \times \text{Average Operation}_{t-1} \\
& + \beta_4 I(\text{Eligible})_{ijt} \times \text{Average Operation}_{t-1} \\
& + \beta_5 I(\text{BOJ operation})_{ijt} \times I(\text{Eligible})_{ijt} \times \text{Average Operation}_{t-1} \\
& + \boldsymbol{\gamma}' \textbf{Controls}_{i,j,t} + \upsilon_{i,j,t},
\end{aligned}
\tag{3}
$$

where $I(\text{Eligible})$ is a dummy variable, which takes the value unity if the corporate bond meets the conditions for the BOJ outright purchase: the bond credit rating categories and the target maturity to buy; *Average Operation* is the cross-sectional average of the BOJ operation dummy in month $t-1$; $I(\text{BOJ operation})$ is a dummy variable defined as above; and $\omega_{k_j,y}$ is the sector*year fixed effect for sector k of firm j.

Figure 9 provides a concise visual representation of the coefficient of interest. "Eligible" in Eq. (3) and Figure 9 is a dummy variable, which takes the value unity if the corporate bond meets the conditions for the outright purchase, that is, the corporate bond credit rating categories, the target maturity to buy, and the sector where the issuer operates.

As the market makes greater use of BOJ operations, other bonds that are eligible ($I(\text{Eligible})$ = 1) but do not attract investors' demand for the BOJ trade (i.e., $I(\text{BOJ operation})$ = 0) experience lower yields, as shown in Figure 9. The effect is economically significant. For example, if investors utilize the BOJ operation for 10% of issues in a given month, the spread on eligible issues with $I(\text{BOJ operation})$=0 decreases by approximately 5%, given a marginal effect of 0.5. This result implies that the BOJ's policy enhances investors' arbitrage behavior, allowing them to exploit the yield gap between eligible corporate bonds with and without demand from the BOJ trading. Conversely, ineligible corporate bonds have a positive coefficient, which means that as the market utilizes the operation more, ineligible long-term corporate bonds face higher spreads. This result suggests a crowding-out effect, which supports Hypothesis 2b (see Appendix C for details of the estimation result).

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4.4 Effect on corporate debt maturity structure

The evidence thus far indicates that the investor demand driven by the BOJ's corporate bond purchase program lowers the credit spreads for the corporate bonds linked to the BOJ trades. When the firms increase the issue amounts of corporate bonds maturing in less than 3 years (5 years during the COVID-19 pandemic), it affects the corporate debt maturity structure. Firms with longer-lived assets have longer-term debt; that is, corporate debt maturity essentially matches the asset maturity (Stohs and Mauer, 1996; Graham and Harvey, 2001; Geelen et al., 2024). However, Custódio et al. (2013) show the supply-side factor in debt markets is a significant factor in debt maturity. To test the effect of the BOJ's corporate bond purchase program, we estimate the following maturity regression based on Custódio et al. (2013); Choi et al. (2018); Geelen et al. (2024):

$$Mat_{it} = \mu_t + \alpha_i + \lambda Ope_{it} + \delta hrat_{it} + \phi Ope_{it} \times hrat_{it} + \beta Control_{it-1} + \epsilon_{it} \tag{4}$$

where Mat_{it} is the measure of debt maturity of firm i in time t: the share of debt maturing in more than 3 years or the share of debt maturing in more than 5 years, which are from LSEG. Explanatory variables include firm fixed effects α_i, year fixed effects μ_t, financial indicators of firm i in year $t-1$; and asset maturity and the logarithm of total assets, cash amounts, and EBITDA as control variables. Asset maturity is calculated as gross property, plant, and equipment over depreciation and amortization times the proportion of property, plant, and equipment in total assets, plus current assets over the cost of goods sold times the proportion of current assets in total assets. Following Geelen et al. (2024), we cap it at 25.

A variable of interest is the BOJ operation variable *Ope*: the ratio of corporate bonds for the BOJ trade in total corporate bonds issued by firm i in year t, *OpeRatio*; or a dummy variable for the BOJ operation targeted firm, *OpeTarget*, taking the value unity for *OpeRatio* > 0. More precisely, $OpeRatio_{it}$ is defined as follows:

$$OpeRatio_{it} = \sum_{k \in K_{it}} \frac{I(BOJ\ operation_{ik})}{\#ofCBissue_{it}} \tag{5}$$

where K_{it} is a set of corporate bonds issued by firm i in year t. The expected association with the dependent variable is negative, as the firms issue larger amounts of bonds maturing in less than 3 years in response to investors' demand for the BOJ trade. We also include the interacted term with the high-grade dummy *hrat*, which takes the value unity for the firm i rated AA or higher in year t.

We expect the high credit quality firm to be more flexible in choosing the debt maturity in response to the supply-side factor; hence, the expected sign for the interaction term is negative.

Table 8 presents the results. In Columns 1 and 2, the asset maturity is significantly positively correlated with the share of debt maturing in more than 3 years. Regarding variables of interest, results indicate that the ratio of corporate bonds for the BOJ trade in total corporate bonds has a decreasing effect on both the share of debt maturing in more than 3 years and the share of debt maturing in more than 5 years of highly rated firms. The BOJ trade is linked to corporate bonds maturing in less than 3 years (5 years during the expansion period in response to the COVID-19 pandemic). Therefore, firms shift from medium- or long-term debts to shorter-term debts (less than 3 years or 5 years, according to the conditions of the eligible bond at that time). Results for BOJ operation-targeted firms in Columns 2 and 4 show a decreasing effect on firms rated AA or higher. High credit quality firms are less likely to suffer from the rollover risk. Hence, the coefficient of the high-grade dummy is significantly negative across specifications. Additionally, high credit quality firms appear to flexibly choose the debt maturity in response to the market's supply-side factor.

4.5   Real effect of the BOJ's corporate bond purchase program

Monetary policy aims to stabilize the economy, not merely to increase the issuance of corporate bonds at lower rates, although the target variables of the monetary policy may slightly differ across time and countries. As the BOJ simultaneously implemented various unconventional policies, these policies could have both complementary and substitution effects. To investigate the effect of the BOJ's corporate bond purchase program on firms' behavior, we use an IV regression employing the BOJ trade dummy based on market news. Specifically, we estimate the following regression to examine the real effects on issuing firms:

$$Outcome_{it} = \mu_t + \delta_{I_i} + \beta_o log(\widehat{New\_Bond}) + Control_{it} + \epsilon_{it} \tag{6}$$

where $log(\widehat{New\_Bond})$ indicates a fitted value of the log amount of newly issued bonds by firm i in year t. μ_t and δ_{I_i} indicate time fixed effect and industry I_i fixed effects, respectively. As the outcome variable, we use the logarithm of investment, the outstanding amount of bank loan, cash holdings, and the loan to total liabilities ratio for firm i. The first stage equation is defined as follows:

$$log(New\_Bond) = \alpha_t + \omega_{I_i} + \beta_B OpeRatio_{it} + Control_{it} + e_{it} \tag{7}$$

where $OpeRatio_{it}$ is a share of the number of corporate bond issues for which the BOJ operation dummy takes the value unity in the total number of issues in year t. α_t and ω_{I_i} indicate time fixed effects and industry I_i fixed effects, respectively. As control variables, we use return on assets and the log of total assets.

Table 9 presents the estimation results. We use the subsample from 2019 to 2024 when the BOJ's purchase program was expanded, and our instrument shows a strong relevance with the amount of newly issued bonds. The F-statistic for the first-stage regression indicates that the weak instrument problem is minor in the estimation. Column 1 shows that the amount of newly issued loans has a significantly positive impact on capital investment. The coefficient on the amount of newly issued bonds is then estimated to be significantly negative, as shown in Column 2. This result suggests that firms that increased their corporate bond issuance because of the BOJ's purchase program reduced their bank loan usage. Thus, the BOJ's policy has a substitution effect. Column 3 presents the result with the logarithm of cash holdings as the dependent variable. The estimated coefficient is negative but insignificant, suggesting that firms with larger amounts of newly issued bonds do not alter their cash usage compared with firms with smaller amounts of new bond issuance. Finally, Column 4 reports the effect on the share of bank loans in total liabilities. The coefficient on newly issued bonds is significantly negative, indicating that firms with newly issued bonds due to the BOJ's operation are more likely to decrease their loan share. This result suggests that firms issuing bonds do not merely reduce borrowing from banks. Rather, these firms are likely to decrease bank loans relative to other debt instruments. Additionally, the impact is economically significant, as a one-percent increase in the amount of newly issued bonds leads to a four-percentage-point decrease in the bank loan share. These results support **H3**. While Darmouni and Siani (2025) report that U.S. bond issuers mainly used funds to accumulate liquid assets, our evidence suggests that the BOJ intervention had real effects in Japan.

4.6 Robustness tests

We conduct robustness tests by examining how our results are affected by alternative policy intervention measures.

4.6.1 Matching

First, in this analysis, one empirical concern relates to unobservables that may drive a spurious relationship, that is, the endogeneity problem. We believe that our identification method of corporate bonds linked to BOJ trade demand sufficiently mitigates the endogeneity issue; however, it may still remain. It is difficult to find an instrument for corporate bond issuance linked to BOJ trade demand, and to find an empirical setting in which companies (quasi-)randomly issue eligible bonds, because the issuance of eligible bonds is not random. Instead, we use a matching approach to address this endogeneity issue. Specifically, we refer to the corporate bonds linked to BOJ trade demand as "treated" bonds. We refer to "control" bonds that are as similar as possible to the treated bonds ex ante. We select the nearest neighbor based on the issue-level characteristics (credit rating and maturity), firm-level characteristics (sales, net income, and EBITDA), and market condition measures (JGB yield, JGB VIX, and Nikkei 225 VI). Nearest neighbors are corporate bonds with the lowest Mahalanobis distance to the treated bonds. Table A2 reports the results indicating that the corporate bonds linked to BOJ trade demand yield lower launch spreads and larger issue amounts compared with the control bonds that are highly similar to the treated bonds. These findings are consistent with the direct *flow* effect (**H1**). Notably, this is inconsistent with an argument that a bond-specific factor determines BOJ trade demand and corporate bond spread and amounts simultaneously.

4.6.2 Alternative approach à la Darmouni and Siani (2025)

Second, we consider an alternative measure of BOJ trade demand to document its effect on the issuer's bond issuance during the expansion period of the corporate bond purchase program in 2020. We employ a similar method as in Darmouni and Siani (2025) by constructing a weight index that is a ratio of the issuer's outstanding bond amounts maturing in less than 5 years to total market outstanding bond amounts maturing in less than 5 years from our dataset. We also calculate the abnormal issue amount by the issuer, which is the amount issued by the issuer in 2020 minus the average annual issuance for that issuer from 2000 to 2019, to account for different cross-firm propensities to rely on bond financing. Then, we run a cross-sectional regression of abnormal firm issuance on the weight in the index by including industry fixed effects and controlling for issuer credit quality and 2019 year-end firm size (total assets). That is, the issuer with a higher weight in the index is assumed to be more affected by the policy intervention and to issue more

bonds than comparable issuers. Table A3 shows that a larger weight in the index increases a firm's propensity to issue relative to its typical issuance amount. This result indicates that the corporate bond purchase program affected firm issuance decisions between comparable firms, conditional on observable characteristics.

We regress corporate debt maturity on the predicted values of the abnormal amount issued in 2020 calculated above. Table A4 reports the cross-sectional result in 2020 when the corporate bond purchase program was expanded. The result suggests that the share of corporate debt maturing in more than 3 or 5 years is significantly more likely to decrease when the firm is more exposed to the intervention. Consistent with results employing marketing news information, the BOJ operation affected bond issuance of firms more exposed to the intervention.

4.6.3 Placebo test with a hypothetical BOJ operation

Although we comprehensively control for both observed and unobserved factors in the baseline regressions—using fixed effects and various firm- and issuance-level variables—one might argue that corporate bonds with the BOJ operation dummy equal to one are inherently more likely to have lower credit spreads and larger issuance amounts, even in the absence of an actual BOJ operation, due to some confounding factors.

To provide supporting evidence that the significant impact of the BOJ operation dummy in the baseline regressions stems from the actual effect of the BOJ operation, we conduct a placebo test using a hypothetical BOJ operation probability. The placebo test follows a two-step procedure.

First, we estimate a prediction model for the BOJ operation dummy using the sample period *after* the BOJ introduced the operation. Specifically, we run the following simple probit regression:

$$y_{i,j,t} = \alpha + \beta_1 X_{i,j,t} + \beta_0 Z_t + \epsilon_{i,j,t} \tag{8}$$

and

$$I(BOJ\ operation) = \begin{cases} 1 & if\ y > 0 \\ 0 & if\ y \leq 0, \end{cases}$$

where $\epsilon_{i,j,t}$ is an error term that is normally distributed with mean 0 and standard deviation 1. $X_{i,j,t}$ and Z_t denote vectors of issuance-level and macroeconomic variables, respectively. Specifically,

$X_{i,j,t}$ includes credit ratings and maturity, while Z_t represents the Nikkei 225 VI. Using the estimation results, we then calculate the fitted probability that the hypothetical BOJ operation dummy takes the value of one, applying this to the sample *before* the introduction of the corporate bond purchase program, that is, before February 2009. In other words, we compute $\Phi(\widehat{y_{i,j,t}})$, where $\Phi(\cdot)$ denotes the cumulative distribution function of the standard normal distribution. The hypothetical probability for the BOJ operation dummy indicates how likely it is that a corporate bond would have been purchased if the program had been introduced prior to its actual implementation.

Second, using the hypothetical probability as an independent variable, we run regressions for the credit spread and issuance amount using the sample for the period *before* the introduction of the program, *from January 2005 to January 2009* as follows,

$$Y_{i,j,t} = \alpha_j + \omega_t + \beta_0 \Phi(\widehat{y_{i,j,t}}) + \boldsymbol{\gamma}' \mathbf{Controls}_{i,j,t} + v_{i,j,t}. \tag{9}$$

If, in the baseline model, the BOJ operation dummy captures some confounding factors rather than investors' demand motivated by the BOJ operation, then the coefficient on the hypothetical probability *before* the introduction is expected to be negative for the credit spread regression and positive for the issuance amount regression.

The estimation results of the probit model based on the sample after the introduction of the purchase program are shown in Table A5. They indicate that corporate bonds with higher credit ratings are more likely to be purchased by investors for the BOJ trade. In addition, shorter maturities are associated with a higher probability of being purchased. The results also show that during periods of volatile stock markets, investors are more likely to utilize the BOJ operation. To assess the goodness of fit, we calculate the receiver operating characteristic (ROC) curve, as shown in Figure A1. The figure demonstrates the strong predictive power of the probit model.

Finally, Table A6 reports the estimation results for the second-step regression, using the hypothetical probability for the BOJ operation dummy as the main independent variable. The first and second columns present the results with the credit spread and issuance amount as the dependent variables, respectively. Column 1 shows that the fitted probability before the introduction of the BOJ operation has a positive coefficient and it is not statistically significant. This result implies that corporate bonds that were more likely to attract investors' demand for the BOJ trade would have had *higher* credit spreads, if any effect existed. Column 2 of Table A6 shows that the fitted probability has a significantly negative coefficient. This sign is opposite to what we find in the

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baseline regression using the sample after the introduction of the program. These results imply that *without the actual BOJ operation*, corporate bonds with the BOJ operation dummy equal to one would have had a smaller issuance amount compared with those with the dummy equal to zero. In other words, we may underestimate the impact of the BOJ operation in the baseline regression, although we do not overestimate it.

Our findings do not change qualitatively even when we construct a hypothetical BOJ operation dummy based on the fitted probability by applying certain thresholds. Specifically, we run a regression using a hypothetical BOJ operation dummy defined as follows:

$$I(hypothetical \widehat{BOJ} operation) = 1 \; if \; \Phi(\widehat{y_{it}}) > p_{threshold}. \tag{10}$$

Although we do not report the results here, we find that the hypothetical BOJ operation has an insignificant or positive effect on credit spreads and a negative effect on issuance amounts.

We also run the baseline regressions using the fitted probability with the sample *after* the introduction of the program, although the results are not reported here. We find qualitatively similar results to those of the baseline regressions: a higher fitted probability is associated with a lower credit spread and a larger issuance amount.

5 Conclusions

This study leverages an LLM to introduce a novel method for identifying corporate bonds linked to investors' intentions of resale to the BOJ. By collecting inside information from investors, news reports capture investor demand; thus, our measures exhibit significant and incremental explanatory power in determining launch spreads and issuance volumes, enabling a precise evaluation of the effects of the corporate bond purchase program on the primary market. The program generates demand for the BOJ trade, with evidence suggesting that it differentially affects launch spreads across deals with and without such demand. Finally, we show that firms increasing corporate bond issuance in response to BOJ purchases tend to reduce bank borrowing.

Our empirical findings have broad policy implications, particularly regarding monetary policy trajectories. The impact of monetary policy on corporate bond pricing influences firms' fundraising costs, even within the same issuer or maturity segment. Given the critical role of debt policy and maturity composition in corporate finance, the effects of monetary policy on market functioning warrant further attention.

This study also opens avenues for future research. We focus on the corporate bond purchase program using marketing news; a natural extension would be to examine the broader mix of unconventional monetary policies, including YCC. Investigating their macroeconomic impact is a logical next step. Additionally, as highlighted by Lucca and Wright (2024), exploring the transmission channels through which YCC affects the corporate debt market remains an important direction for future work.

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Table 1: Major modification of target corporate bonds for market operations by the Bank of Japan

Announcement Date	Single issuer's corporate bonds to be purchased		
	Maximum amount	Ratio	Eligible corporate bonds: Credit rating; remaining maturity
February 19, 2009	*Expand Special Funds-Supplying Operations to Facilitate Corporate Financing*		
	50 billion yen (through end of 2009)	25%	Rated A or higher; Up to one year
October 5, 2010	*Announce Asset Purchase Program*		
October 28, 2010	100 billion yen	25%	Rated BBB or higher; One to two years
April 27, 2012	100 billion yen	25%	Extend the remaining maturities from 'one to two years' to 'one to three years'
April 4, 2013	*Introduce QQE*		
April 27, 2020	300 billion yen	30%	Extend the remaining maturities from 'one to three years' to 'one to five years'
December 17, 2021	300 billion yen	30%	Decide to terminate the extension of remaining maturities to five years in March 2022
February 25, 2022	250 billion yen (effective in April 2022)	30%	Rated BBB or higher
March 22, 2022	*End of purchasing three- to five-year corporate bonds*		
August 31, 2022	200 billion yen (effective in October 2022)	30%	Rated BBB or higher; One to three years
November 30, 2023	150 billion yen (effective in January 2024)	30%	Rated BBB or higher; One to three years
February 29, 2024	100 billion yen (effective in April 2024)	25%	Rated BBB or higher; One to three years
March 29, 2024	*Decide to gradually reduce the amount of purchases of corporate bonds*		
January 20, 2025	*Last auction*		

Source: Various issues of the Bank of Japan's Statements on Monetary Policy and Monetary Policy Releases.

Table 2: Descriptive statistics

Variable name	Obs.	25%	Median	Mean	75%	Std. Dev.
Dependent variables						
log(launch spread)	8385	3.04	3.47	3.43	3.82	0.64
log(issue amount)	8429	9.21	9.21	9.51	9.9	0.79
Marketing range	4612	2	4	4.63	5	5.08
Corporate bond variables						
Maturity (years)	8429	5	6	8.22	10	6.14
I (BOJ operation)	8429	0	0	0.05	0	0.22
I (Green bond)	8429	0	0	0.04	0	0.19
Credit rating (dummies)						
AAA	8429	0	0	0.01	0	0.09
AA	8429	0	0	0.33	1	0.47
A	8429	0	1	0.56	1	0.50
BBB	8429	0	0	0.1	0	0.30
BB	8429	0	0	0.0004	0	0.02
Corporate financial variables						
log(sales)	5923	12.75	13.74	13.27	14.53	2.11
log(net income)	5951	9.27	10.36	10.13	11.37	1.89
log(EBITDA)	5822	10.51	11.64	11.27	12.58	1.99
Corporate variables in maturity structure and real effect analysis						
% debt maturing > 3y	2004	35.47	49.41	48.61	62.0	17.51
% debt maturing > 5y	2111	16.27	31.80	31.43	44.44	18.80
Asset maturity	2111	2.61	5.13	9.40	14.82	8.49
log(bank loan)	555	11.26	12.15	12.14	13.25	1.57
bank loan share	575	0.17	0.30	0.34	0.44	0.22
log(cash holding)	2106	10.07	10.91	11.05	11.99	1.39
cash ratio	575	0.04	0.07	0.10	0.11	0.09
log(investment)	534	10.08	11.00	11.91	12.00	1.47
log(total assets)	2106	12.93	13.82	13.85	14.66	1.21
Market condition measures						
JGB yield	8424	-2	21.1	38.78	63.45	54.62
JGB VIX	7465	1.69	2.41	2.73	3.44	1.30
Nikkei 225 VI	8429	17.61	20.76	22.46	25.49	7.58

Notes: The full sample is from January 2005 to December 2023.

Table 3: Glossary of empirical measures

Measure	Description
Launch spread	The spread between the coupon rate of the corporate bond at issuance and the yield of the Japanese government bond with the same maturity (unit is basis points)
Marketing spread	The credit spreads that the underwriter quoted to potential investors in the marketing process.
Marketing range	The (high-low) range of marketing spreads on each corporate bond offered in the marketing process (unit is basis points)
JGB yield	JGB yield with the same maturity as the issued corporate bond (unit is basis points)
JGB VIX	Implied volatility of Japanese government bonds using options on 10-year JGB futures
I(BOJ operation)	BOJ operation dummy, taking the value unity for the corporate bond issue linked to the investor's intentions of resale to the BOJ, and zero otherwise
Average Operation	Cross-sectional average of the BOJ operation dummy in month
OpeRatio	Ratio of corporate bonds for the BOJ trade in total corporate bonds issued by firm i in year t

Table 4: BOJ operation variable: Effects of BOJ trade demand and eligible bonds

	Launch spread			Issue amount		
	(1)	(2)	(3)	(4)	(5)	(6)
I(Eligible)	-0.256***		-0.160***	0.174***		0.120***
	(0.025)		(0.026)	(0.028)		(0.031)
I(BOJ operation)		-0.356***			0.224***	
		(0.033)			(0.036)	
I(Eligible)$\times$ I(BOJ operation)			-0.227***			0.127***
			(0.038)			(0.039)
Firm Fixed Effects	YES	YES	YES	YES	YES	YES
Time Fixed Effects	YES	YES	YES	YES	YES	YES
Market Controls	YES	YES	YES	YES	YES	YES
Observations	7633	7633	7633	7651	7651	7651
R^2	0.71	0.71	0.71	0.71	0.71	0.71

Notes: This table presents regressions that compare the effects of eligible corporate bonds and corporate bonds linked to BOJ trade demand on the launch spread and issue amounts of corporate bond offerings. Firm fixed effects, time fixed effects, and market control variables are included. Standard errors (SEs) multiclustered at the firm and time level are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Table 5: BOJ operation and launch spread

	Benchmark		With financial controls	
	(1)	(2)	(3)	(4)
I(BOJ operation)	-0.233***	-0.247***	-0.217***	-0.229***
	(0.033)	(0.033)	(0.031)	(0.037)
Marketing range		0.015***		0.015***
		(0.004)		(0.006)
AAA rating	-0.880***	-0.430***	-0.899***	-0.562***
	(0.102)	(0.108)	(0.129)	(0.146)
AA rating	-0.987***	-0.699***	-1.035***	-0.844***
	(0.083)	(0.084)	(0.093)	(0.114)
A rating	-0.466***	-0.348***	-0.484***	-0.436***
	(0.059)	(0.047)	(0.058)	(0.066)
Maturity	0.018***	0.016***	0.018***	0.018***
	(0.002)	(0.003)	(0.002)	(0.003)
I(Green bond)	0.003	0.032	-0.009	0.003
	(0.036)	(0.039)	(0.040)	(0.047)
Firm Fixed Effects	YES	YES	YES	YES
Time Fixed Effects	YES	YES	YES	YES
Controls	NO	NO	YES	YES
Observations	8385	4563	5156	2736
R^2	0.78	0.81	0.80	0.83

Notes: This table presents the estimation results of Equation (1) using the logarithm of launch spread in basis points for the corporate bond issue i by firm j at time t as a dependent variable. Column 1 presents the baseline results, where the independent variables are a dummy variable *I*(BOJ operation), credit rating dummies, maturity of the bond, and a dummy variable for green bonds. We introduce a marketing range variable in Columns 2 and 4. Columns 3 and 4 present results adjusted for corporate financial controls, which include the logarithm of sales, net income, and EBITDA. The baseline credit rating category is BBB or lower. Firm fixed effects and time fixed effects are included. Standard errors (SEs) multiclustered at the firm and time level are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Table 6: Credit risk and the BOJ trade: Launch spread

	I(BOJ operation)=1		All samples	
	(1)	(2)	(3)	(4)
Maturity	0.265***	0.232***	0.020***	0.019***
	(0.031)	(0.025)	(0.002)	(0.002)
AAA rating		-0.025	-0.977***	-0.907***
		(0.204)	(0.109)	(0.129)
AA rating		-0.066	-1.047***	-1.061***
		(0.165)	(0.084)	(0.096)
A rating		-0.062	-0.472***	-0.494***
		(0.143)	(0.058)	(0.064)
I(BOJ operation) × AAA rating			0.026	
			(0.135)	
I(BOJ operation) × AA rating			0.063	0.012
			(0.047)	(0.056)
I(BOJ operation) × A rating			-0.364***	-0.314***
			(0.024)	(0.035)
I(BOJ operation) × BBB rating			-0.332***	-0.334**
			(0.082)	(0.134)
Firm Fixed Effects	YES	YES	YES	YES
Time Fixed Effects	YES	YES	YES	YES
Controls	NO	NO	NO	YES
Observations	479	412	8605	5187
R^2	0.76	0.95	0.78	0.81

Notes: This table presents the estimation results of Equation (1) using the logarithm of launch spread in basis points for the corporate bond issue i by firm j at time t as a dependent variable. Columns 1 and 2 present the results whose observations are restricted to the corporate bonds with I(BOJ operation)=1. Columns 3 and 4 present results from all samples, where the independent variables include the interactions of credit rating dummies and I(BOJ operation). Column 4 reports the results, including financial controls. The baseline rating category is BBB or lower. Firm fixed effects and time fixed effects are included. Standard errors (SEs) multiclustered at the firm and time level are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Table 7: The BOJ operation and issue amount

	Benchmark		With financial controls	
	(1)	(2)	(3)	(4)
I(BOJ operation)	0.151***	0.175***	0.111**	0.114*
	(0.035)	(0.044)	(0.053)	(0.062)
Marketing range		0.002		0.003
		(0.003)		(0.005)
AAA rating	0.460***	0.619***	0.891***	1.004***
	(0.131)	(0.163)	(0.168)	(0.177)
AA rating	0.121*	0.135	0.149*	0.111
	(0.072)	(0.108)	(0.081)	(0.138)
A rating	0.034	-0.055	0.047	-0.127
	(0.060)	(0.085)	(0.064)	(0.115)
Maturity	-0.014***	-0.015***	-0.010***	-0.011***
	(0.003)	(0.003)	(0.002)	(0.003)
Firm Fixed Effects	YES	YES	YES	YES
Time Fixed Effects	YES	YES	YES	YES
Controls	NO	NO	YES	YES
Observations	8429	4571	5185	2744
R^2	0.71	0.66	0.76	0.69

Notes: This table presents the estimation results of Equation (1) using the logarithm of issue size in millions of JPY of bond i by firm j at time t as a dependent variable. Column 1 presents the baseline results, where the independent variables are a dummy variable I(BOJ operation), credit rating dummies, and maturity of the bond. We introduce a marketing range variable in Columns 2 and 4. Columns 3 and 4 present results adjusted for corporate financial controls. The baseline rating category is BBB or lower. Firm fixed effects and time fixed effects are included. Standard errors (SEs) multiclustered at the firm and time level are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Table 8: Effect of the BOJ's purchase program on corporate debt maturity

|	% debt maturing > 3y		% debt maturing > 5y	
	(1)	(2)	(3)	(4)
OpeRatio	1.785		3.603	
	(1.577)		(2.831)	
High-grade × OpeRatio	-8.681**		-11.493**	
	(3.664)		(5.419)	
OpeTarget		2.073**		2.558*
		(0.888)		(1.397)
High-grade × OpeTarget		-5.651**		-6.378*
		(2.177)		(3.432)
High-grade	-5.876***	-5.838***	-6.164**	-6.186**
	(1.827)	(1.817)	(2.257)	(2.291)
Asset maturity$_{t-1}$	0.252**	0.241**	0.101	0.083
	(0.107)	(0.107)	(0.159)	(0.159)
Firm Fixed Effects	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES
Controls	YES	YES	YES	YES
Observations	2004	2004	2111	2111
R^2	0.65	0.65	0.63	0.63

Notes: The table reports the estimation results of equation Eq. (4) where the dependent variable is *% of debt maturing in > 3 years* in Columns 1 and 2 and *% of debt maturing in > 5 years* in Columns 3 and 4. Year fixed effects and firm fixed effects are included. Standard errors (SEs) multiclustered at the firm and time level are in parentheses. *** significant at 1%, ** significant at 5%, * significant at 10%.

Table 9: Real effect of the BOJ's purchase program

|	(1) Investment	(2) Bank Loan	(3) Cash	(4) Loan Share
log(NewBond$_t$)	0.451*	-0.573*	-0.046	-0.043*
	(0.248)	(0.308)	(0.130)	(0.025)
log(BankLoan$_{t-1}$)	0.068	0.638***	-0.032	0.809***
or BankLoanShare$_{t-1}$	(0.042)	(0.080)	(0.025)	(0.052)
CashRatio$_{t-1}$	-0.893*	-1.166**	0.887***	-0.117***
or log(Cash$_{t-1}$)	(0.475)	(0.548)	(0.032)	(0.044)
log(Assets$_{t-1}$)	0.578***	0.766***	0.163	0.028*
	(0.191)	(0.240)	(0.125)	(0.016)
First stage F-stats (Kleibergen-Paap)	9.875	10.392	10.722	11.096
Year FE	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes
N	534	552	555	575
adj. R^2	0.653	0.874	0.945	0.927

Notes: This table presents the estimated results of IV regressions, where the dependent variable is the logarithm of the amount of capital investment, bank loan, cash, or the bank loan-to-total liabilities ratio. Robust standard errors (SE) are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Figure 1: Composition of annual issuance by maturity
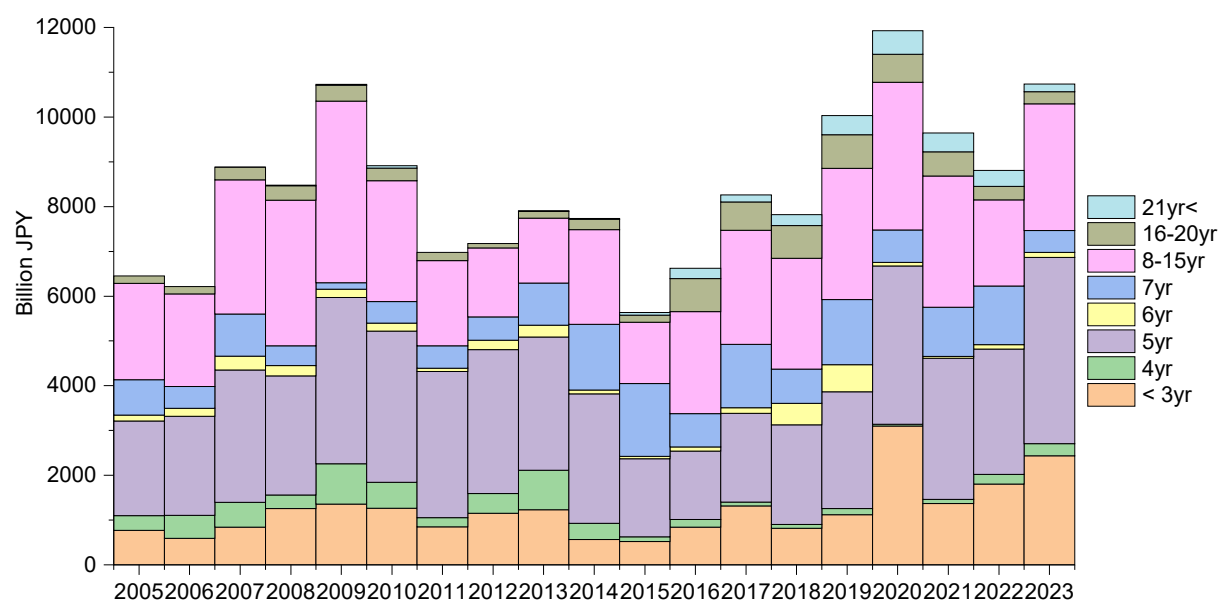
Notes: Annual amounts of corporate bond issuance (principal amount) in each of the maturity ranges. The data are taken from LSEG Eikon.

Figure 2: Identification of BOJ trade demand for individual bond issues
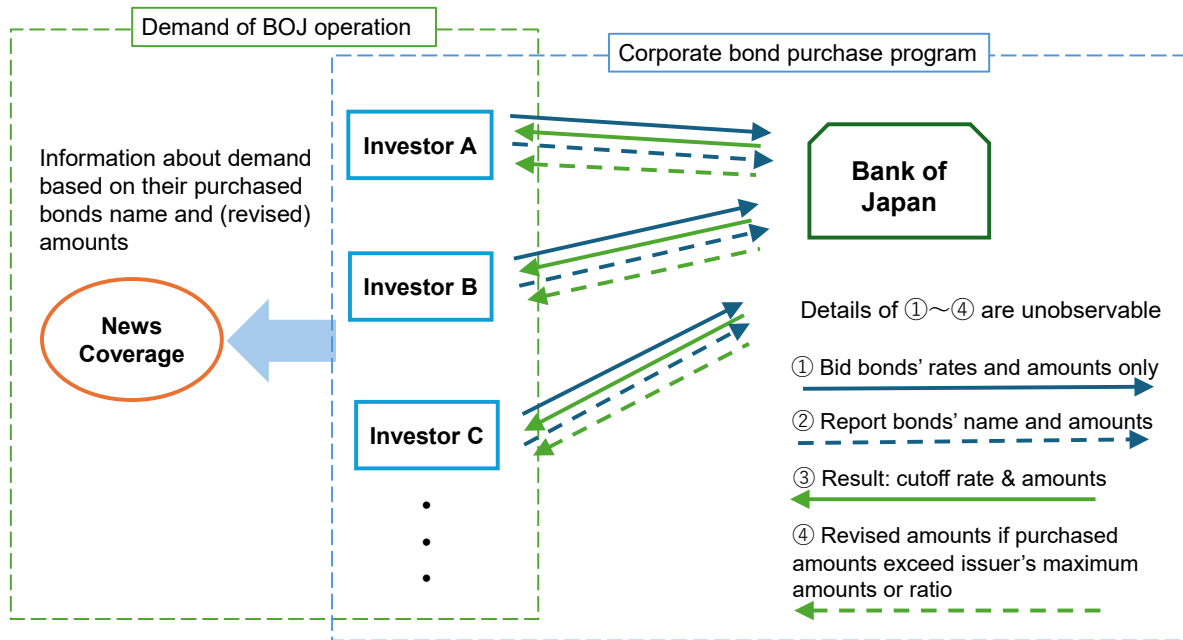
Notes: This panel provides a diagram in which we identify the BOJ trade demand for individual bond issues using news information.

Figure 3: Corporate bond marketing timeline
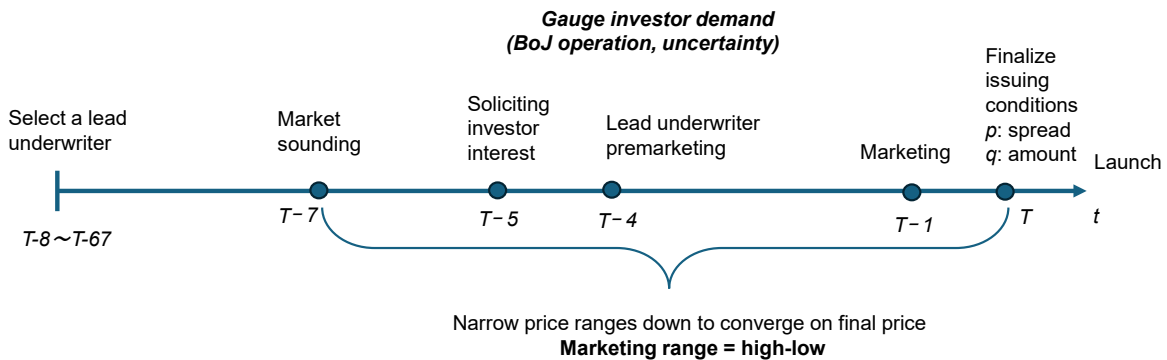
Notes: This figure presents the timeline of the bond offering marketing process to determine the launch spread and issue amounts. The lead underwriter is selected from two months to one business day before the market sounding, depending on the bond issuance frequency of the issuer. Lead underwriter market sounding takes two business days, and soliciting investor demand takes one business day. Subsequently, premarketing by the lead underwriter takes three business days, and the final conditions are determined the next business day.

Figure 4: The BOJ corporate bond operation results

Bid-to-cover ratio
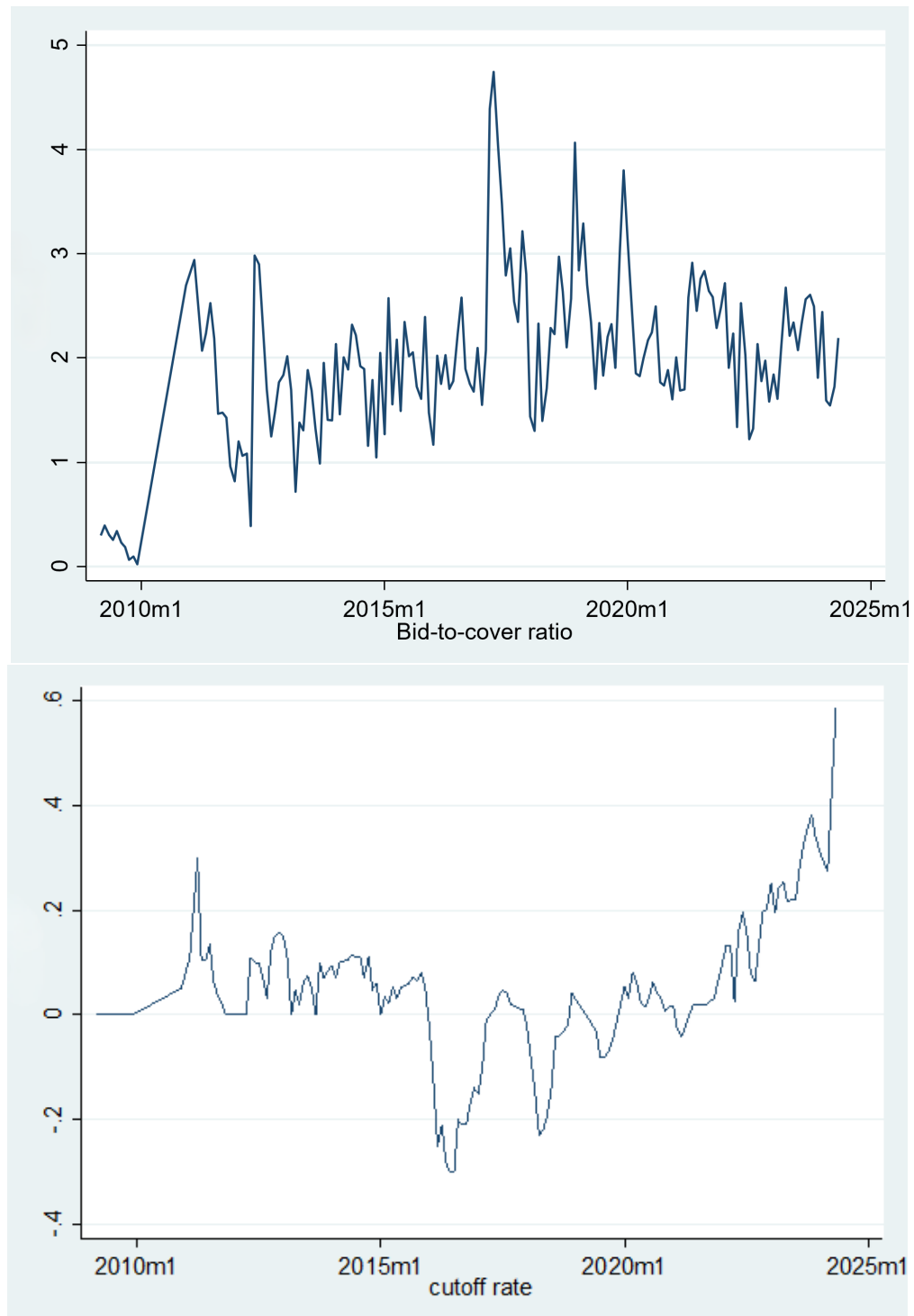
cutoff rate

Notes: The upper and lower panels show the monthly averages of the bid-to-cover ratio and the cutoff rate in the outright purchases of corporate bonds, respectively.

Figure 5: The BOJ purchase amounts of corporate bonds
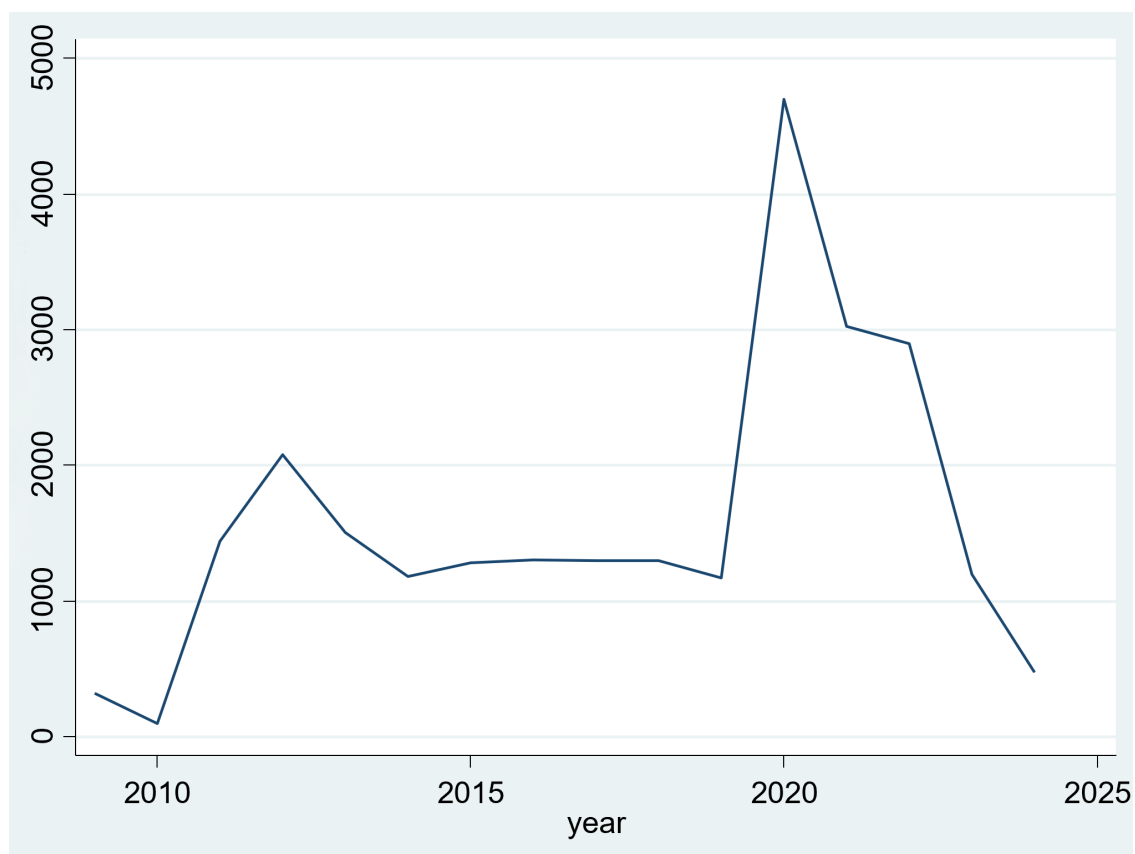
Notes: Annual amounts of corporate bond purchased (billion JPY) by the BOJ.

Figure 6: Expansion of the corporate bond purchase program and amounts of competitive bid
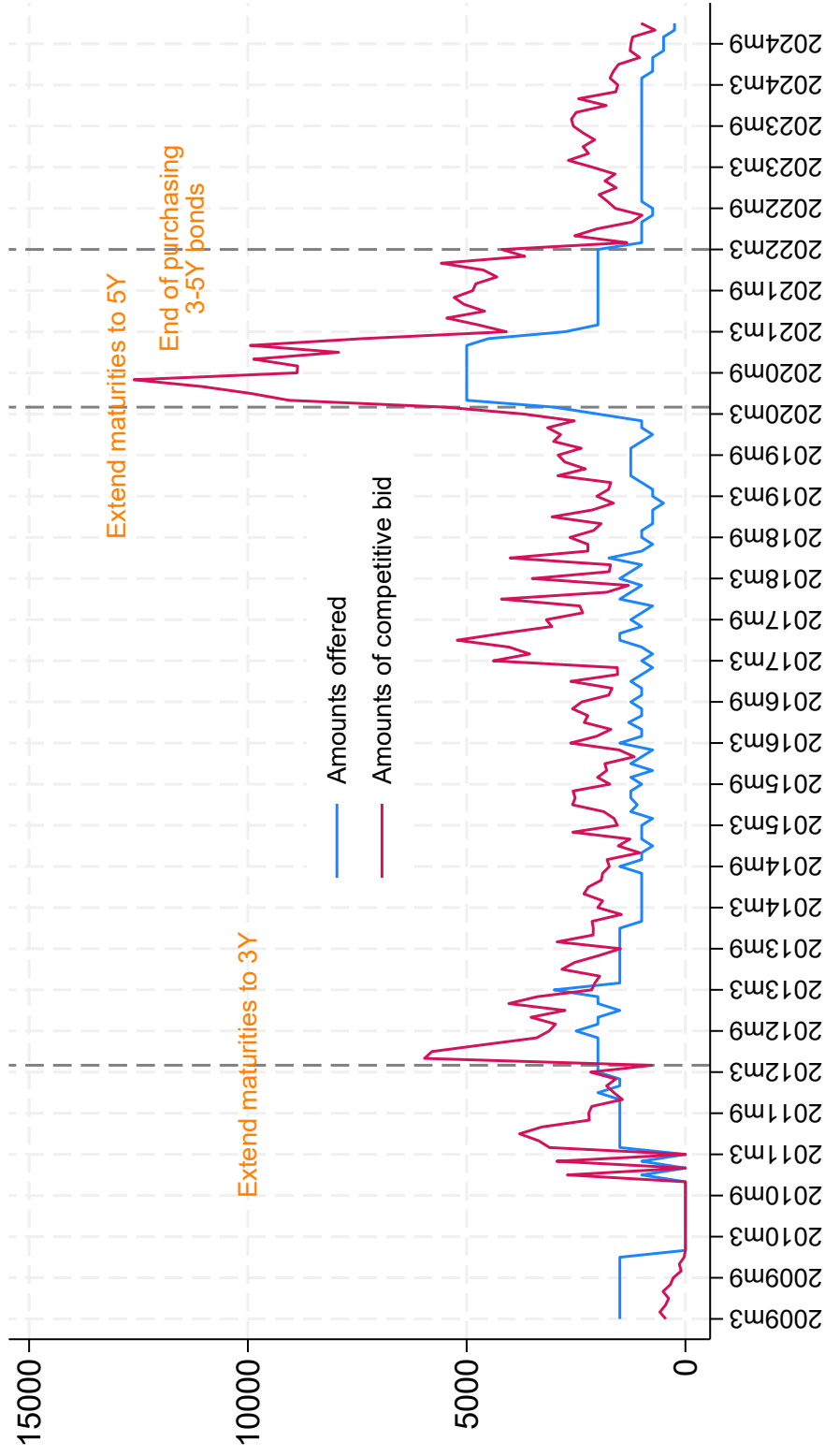
Notes: The graph plots the monthly amounts offered and amounts of competitive bids (a hundred million yen) in the corporate bond purchase operation.

Figure 7: Share of corporate bonds issuance with the demand of investors for the BOJ trade
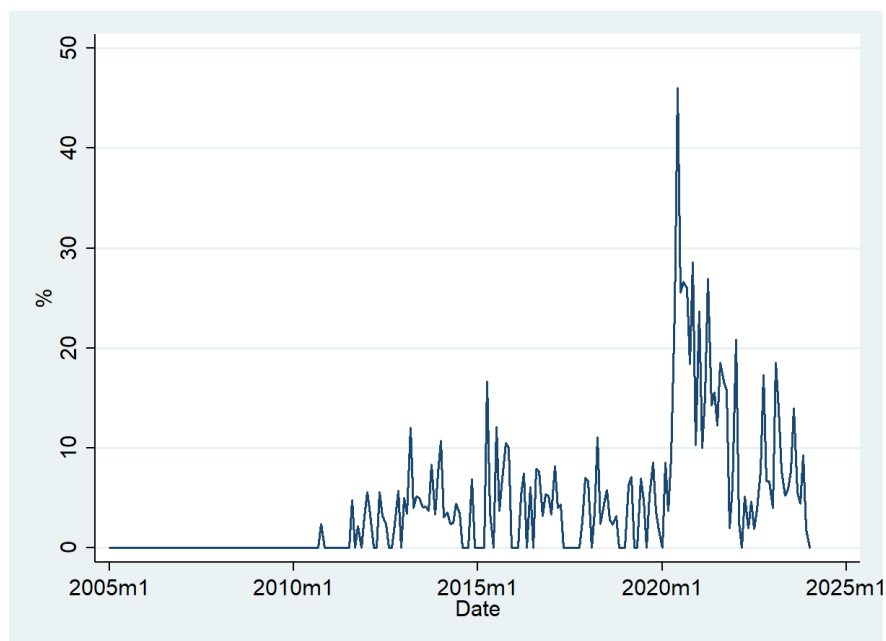
Notes: The figure shows the share of corporate bond issuance with the BOJ operation dummy equal to one, as a percentage of the total issuance each month.

Figure 8: Issue amounts of eligible corporate bonds and BOJ trade demand
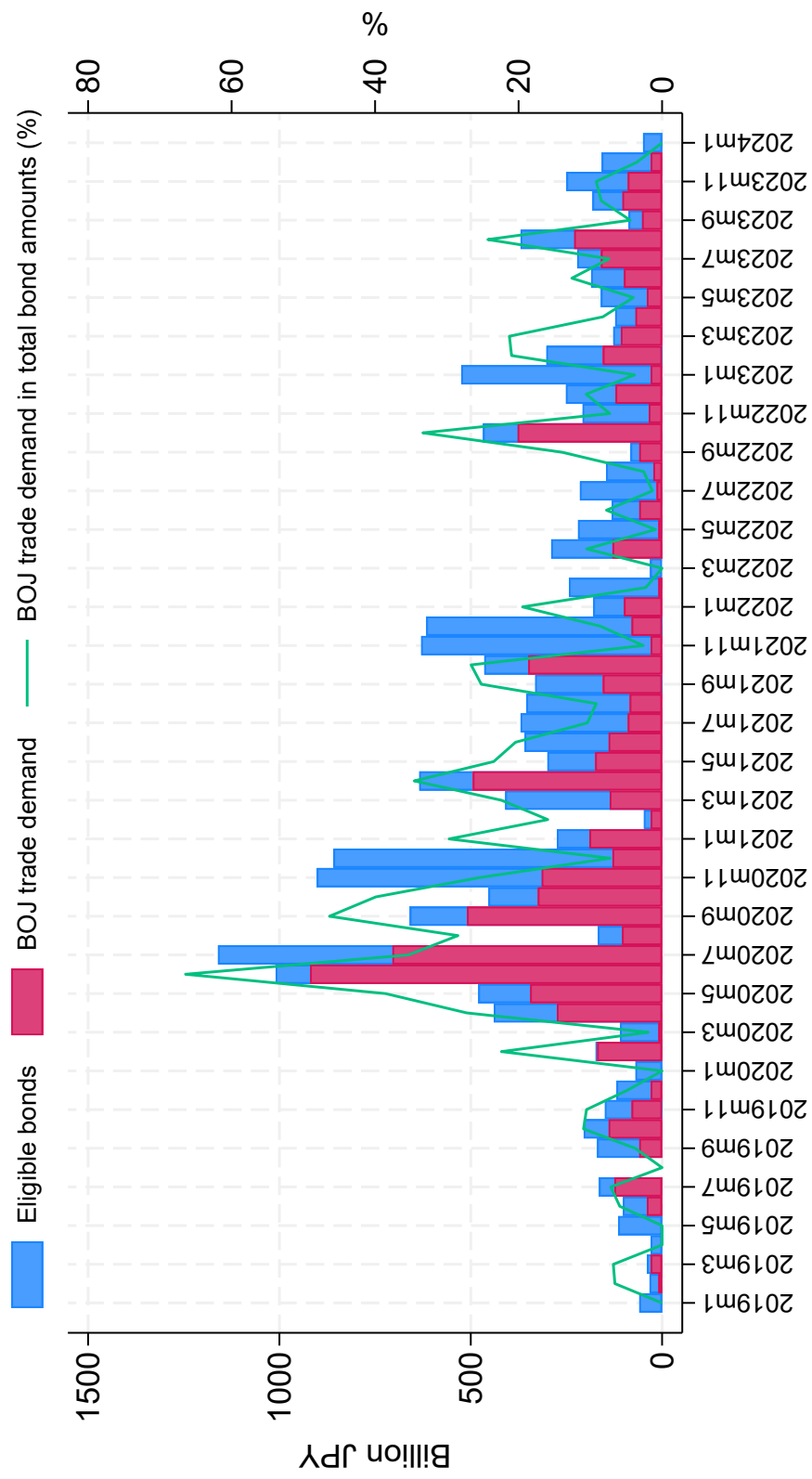
Notes: This figure plots monthly corporate bond issue amounts of eligible corporate bonds and corporate bonds linked to the BOJ trade in one billion yen along with BOJ trade demand in total bond amounts (%).

Figure 9: Spillover effect of the BOJ's purchase program on launch spreads
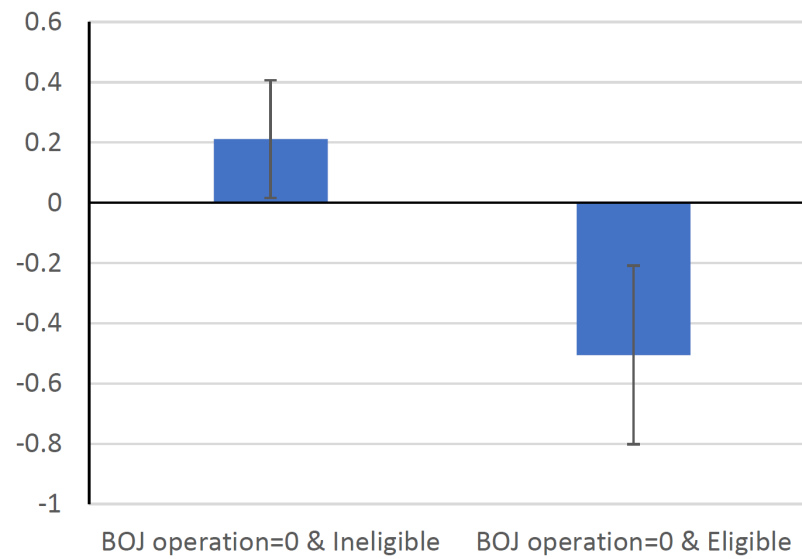
Notes: The figure shows the estimated impact of the monthly average operation dummy (one-month lagged) based on the estimation of Eq. (3). The left bar represents the impact on ineligible issues, while the right bar represents eligible issues with the BOJ operation dummy equal to 0. The lower and upper whiskers represent the 10th and 90th percentiles of the confidence interval for the estimates, respectively.

Appendices

A   Prompt for information extraction

Main part of the prompt transalated into English

```
From the following text and table, extract information about corporate
    bond issuance projects, including the issuing company name, issuance
     series, maturity, rating, redemption date, issuance amount,
    issuance spread (rate), and dates of any condition changes, covering
     the initial plans in the marketing, hearing, and sounding stages,
    as well as any subsequent changes. Represent spreads as either
    government bond spreads or LIBOR spreads (L+).

Extract all dates and details regarding the initial planned content,
    issuance amount, and spread (rate) when changes occurred. Your
    response should be in table format, with the following columns:

1. Issuing company name (use the official name),
2. Issuance series,
3. Maturity (in years),
4. Rating,
5. Redemption date,
6. Date of condition changes (YYYY/MM/DD),
7. Issuance amount,
8. Issuance rate (range: x%--y%),
9. Procedural stage (e.g., sounding, hearing, or marketing),
10. A dummy variable indicating the presence of demand from investors
    for Bank of Japan operations (1 if terms such as "Bank of Japan
    operation," "in line with Bank of Japan operation," "Bank of Japan
    purchase," or similar expressions are present in the text; otherwise
    , 0),
11. Relevant text excerpts indicating condition changes,

Provide your final response in table format only.

The text is as follows: "{maintext}"
```

B Definitions of variables

Variable	Definition
Asset maturity	Gross property, plant, and equipment over depreciation and amortization times the proportion of property, plant, and equipment in total assets, plus current assets over the cost of goods sold times the proportion of current assets in total assets; we cap it at 25 years
Average Operation	See Table 3
Bank loan	Log of Bank loan in one million yen
Cash holdings	Log of cash and cash equivalents in one million yen
Credit rating	Creditworthiness of corporate bonds: (highest) AAA, AA, A, BBB, and BB
Credit (launch) spread	Difference between the corporate bond yield to maturity at issuance and JGB yields of corresponding maturity (bp)
EBITDA	Log of earnings before interest, taxes, depreciation, and amortization in one million yen
Investment	Change in property, plant, and equipment from a previous period, plus depreciation and amortization
JGB yield	See Table 3
JGB VIX	See Table 3
I(BOJ operation)	See Table 3
Launch spread	See Table 3
Marketing spread	See Table 3
Marketing range	See Table 3
Maturity	Length of time until the company has to pay back the principal to investors in years
OpeRatio	See Table 3
Net income	Log of net income in one million yen
% debt maturing $> 3y$	Ratio of long-term debt minus debt maturing in 2 and 3 years over total debt
% debt maturing $> 5y$	Ratio of long-term debt minus debt maturing in 2, 3, 4, and 5 years over total debt
Sales	Log of sales in one million yen

C Estimation result for the spillover effect

In Section 5.2, we estimated the panel regression with the triple interaction of the BOJ operation dummy, the eligible dummy, and the average BOJ operation dummy in the previous month to investigate the spillover effect. The details of the estimation results are shown in Table C1.

Table A1: Spillover effect

	Launch spread
(1-I(BOJ operation))*Ineligible*AverageOperation	0.212*
	(0.119)
(1-I(BOJ operation))*Eligible*AverageOperation	-0.505***
	(0.180)
I(BOJ operation)*Eligible*AverageOperatione	-0.368*
	(0.200)
AAA rating	-0.398***
	(0.124)
AA rating	-0.567***
	(0.097)
A rating	-0.393***
	(0.070)
Maturity	0.014***
	(0.003)
I(BOJ operation)	-0.211***
	(0.053)
Marketing range	0.012***
	(0.004)
Nikkei 225 VI	0.010***
	(0.002)
JGB VIX	0.035*
	(0.018)
Firm Fixed Effects	Yes
Sector*Year Fixed Effects	Yes
N	4495
R^2	0.787

$Notes$: Standard errors (SEs) multiclustered at the firm and time level are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

D Robustness tests

Table A2: Average treatment effects (ATEs)

| | (1) | (2) |
	Launch spread	Issue amount
ATE		
Corporate bonds linked to BOJ trade demand	-0.335***	0.305***
	(-7.13)	(5.21)
Observations	4620	4632
Matching method	Nearest-neighbor matching	

Notes: We select the nearest neighbor based on the issue-level characteristics (credit rating and maturity), firm-level characteristics (sales, net income, and EBITDA), and market condition measures (JGB yield, JGB VIX, and Nikkei 225 VI). *t* statistics in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Table A3: Weight index and abnormal issue amounts (Bn)

	(1)	(2)
Weight Index	5.684**	4.915*
	(2.451)	(2.355)
AA rating	51.958***	50.950***
	(12.566)	(10.959)
A rating	30.068***	28.177***
	(4.953)	(5.908)
$\log(\text{Asset})_{t-1}$		5.167
		(4.934)
Industry Fixed Effects	YES	YES
Observations	104	100

Notes: Reports estimates of the regression equation $AbnormalAmtIssued_i = gWeightIndex_i + bX_i + \delta_{Ii} + \epsilon_i$, where abnormal issuance is the amount issued by the firm in 2020 minus the average annual issuance for that firm during 2000-2019. Weight Index is multiplied by 10^3. Total assets are at the firm level. We also control for credit rating and industry fixed effects. Standard errors are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Table A4: Corporate debt maturity and policy intervention

	% debt maturing > 3y	% debt maturing > 5y
	(1)	(2)
Predicted abnormal amount	-0.341***	-0.266**
	(0.076)	(0.077)
Asset maturity$_{t-1}$	1.063***	0.796**
	(0.104)	(0.247)
Industry Fixed Effects	YES	YES
Controls	YES	YES
Observations	253	266

Notes: Reports estimates of the regression equation $Mat_i = \phi Abnormal\hat{A}mtIssued_i + bX_i + \delta_{Ii} + \epsilon_i$, where Mat_i is the share of debt maturing in more than 3 years or the share of debt maturing in more than 5 years, $Abnormal\hat{A}mtIssued$ is the predicted value of abnormal amount issued in 2020, and X is controls including asset maturity, total assets, cash holdings, and EBITDA at the firm level in 2019. Standard errors, in parentheses, are clustered by sector level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Table A5: Estimation result for the probit model of the BOJ operation dummy

|	(1)
AAA rating	1.691***
	(0.275)
AA rating	1.055***
	(0.140)
A rating	1.052***
	(0.135)
Maturity	-0.616***
	(0.027)
Nikkei 225 VI	0.027***
	(0.005)
Observations	6781

Notes: The table reports the estimation results for the probit model with the BOJ operation dummy, based on samples from February 2009 to December 2023. Standard errors, in parentheses, are clustered by sector level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Table A6: Placebo test for the impact of hypothetical probability of the BOJ operation dummy before program introduction

Dependent variable	(1) Launch spread	(2) Issue amount
$\Phi(\widehat{y_{it}})$	0.165	-0.610***
	(0.112)	(0.136)
AA rating	-0.784***	-0.613**
	(0.153)	(0.273)
A rating	-0.344***	-0.222*
	(0.063)	(0.115)
Maturity	0.034***	-0.034***
	(0.005)	(0.010)
Nikkei 225 VI	0.004	0.011*
	(0.004)	(0.006)
Firm fixed effect	YES	YES
Time fixed effect	YES	YES
Observations	1251	1281

Notes: The table reports the estimation results for the launch spread and issue amount using samples from January 2005 to January 2009, when the corporate bond purchase program had not yet been introduced. $\Phi(\widehat{y_{it}})$ denotes the fitted probability based on the probit model shown in Table A5. To increase the sample size, the marketing range, JGB VIX, and issuing firms' financial data are not included as independent variables, unlike in the baseline regression. However, including these control variables does not qualitatively change the results. Standard errors, in parentheses, are clustered by sector level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Figure A1: ROC curve of the estimated probit model
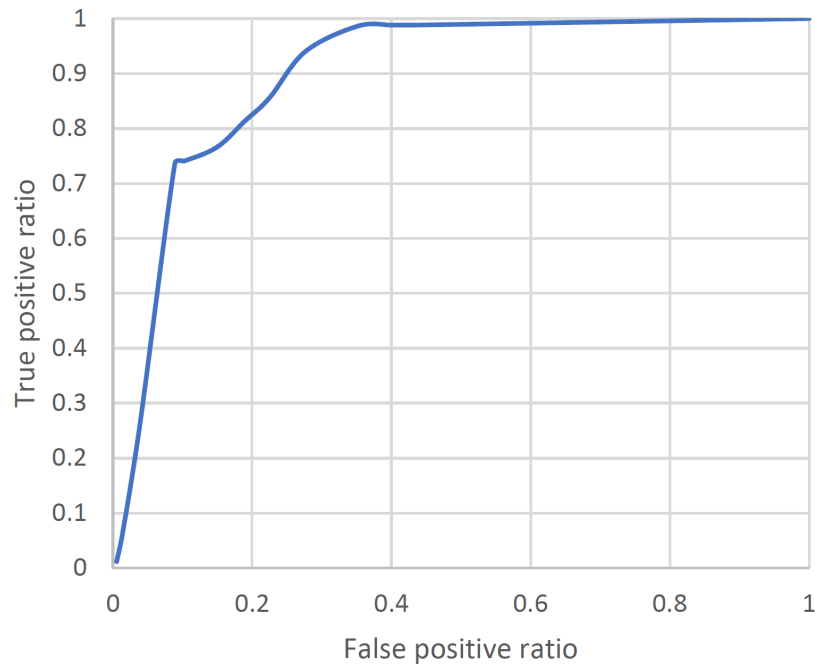
Notes: The figure shows the ROC curve based on the estimation results of the probit model presented in Table A5.