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Maturity Clienteles and Corporate Bond Maturities

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Abstract

The average maturity of newly issued corporate bonds has declined substantially over the past 40 years, and the traditional determinants of debt maturity fail to explain this decline fully. We show that the changing composition of investors in the corporate bond market influences bond maturities. The results of a Granger causality test, an instrumental variable approach, and a natural experiment suggest that a decline in the insurance companies' – which prefer long-term bonds – ownership share in the corporate bond market explains a significant part of the unexplained maturity decline. These findings illustrate how investor preferences can have real effects on corporations.

I. Introduction

From 1975 to 2015, the average maturity of new corporate bond issues in the U.S. declined from 20 to 10 years. Understanding this decline is important because distortions to debt maturity can alter firms' financing and investment decisions (e.g., Myers (1977), Aivazian, Ge, and Qiu (2005), and Harford, Klasa, and Maxwell (2014)). Custódio, Ferreira, and Laureano (2013) show that the decline in average long-term-debt-to-total-debt ratios during this period varies with the changing characteristics of firms, but these firm characteristics and other traditional determinants of debt maturity cannot fully explain the decline in the maturities of new bond issues. In this article, we examine whether changes in the aggregate investor base in the corporate bond market influence this maturity decline.

Insurance companies are major investors in the U.S. corporate bond market. Bond capital from insurance companies is an important source of long-term

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financing for corporations because insurance companies invest heavily in long-term bonds to offset their exposure to interest rate risk on their long-term liabilities. Long-term bonds also help insurance companies secure a predictable income and achieve their long-term investment goals.

The share of insurance company ownership in the U.S. corporate bond market has declined from 40% to 25% over the last 4 decades because the corporate bond market and the mutual fund industry grew faster than the insurance industry.[1] Mutual funds are now the second-largest investors in the U.S. corporate bond market. They tend to invest in shorter maturity bonds compared to insurance companies because they face liquidity and redemption risks. We examine how firms respond to the change in the investor base and whether their responses contribute to the decline in bond maturities since the 1970s.

We use a sample of over 19,000 new bonds issued by public U.S. industrial firms between 1975 and 2015 to test our hypothesis that the change in the aggregate investor base in the corporate bond market contributes to the decline in bond maturity and find that it does. First, we examine the maturity preferences of insurance companies and mutual funds controlling for other bond-, issuer-, and macro-level covariates. We confirm the conventional wisdom that insurance companies invest more in longer maturity bonds and mutual funds invest more in shorter maturity bonds. We then turn to our main analysis: examining the trend in bond maturities.

To begin, we reproduce the bond maturity trend tests in Custódio et al. (2013). We find, as they do, that after controlling for its traditional determinants, bond maturity declines by a statistically significant and economically large amount: an average of 1.5 months each year. This amount is equivalent to a total unexplained decline of 5 years during the sample period, which is about half of that reported in Custódio et al. (2013). Even this comprehensive set of firm-, bond-, and macro-level covariates fails to explain fully the substantial decline in bond maturities observed since the 1970s.

We then include the aggregate share of insurance company ownership in the corporate bond market (i.e., "insurer market share") as an additional control. When controlling for insurer market share, we find not only that insurer market share is significantly positively related to bond maturity, but also and more importantly, that the maturity decline becomes insignificant. This finding, which is robust to a variety of specifications and approaches, suggests that the declining share of insurance company ownership in the corporate bond market explains a significant part of the unexplained maturity decline. On the other hand, the maturity decline remains significant when controlling for market shares of mutual funds or other investors.

Is the relationship between insurer market share and bond maturity driven by the decline in the demand for corporate bonds from insurers or by the decline in the supply of corporate bonds that insurers prefer? Baghai, Servaes, and Tamayo (2014) show that credit rating agencies have become more conservative over time. This change in rating standards reduces the number of investment-grade issuers whose bonds insurance companies prefer. Accordingly, the decline in insurer market share may be driven by the decline in the supply of investment-grade corporate bonds that

[1] According to the U.S. flow of funds data published by the Federal Reserve.

tend to have longer maturities. To distinguish demand-side explanations from supply side explanations, we first run a Granger causality test and find that insurer market share Granger causes bond maturity, but not vice versa. This finding is consistent with the demand channel and inconsistent with the supply channel.

Next, we instrument for insurer market share with the government debt-to-GDP ratio. As this ratio increases, Treasury bond yields increase (Krishnamurthy and Vissing-Jorgensen (2012)), making Treasuries relatively more attractive and corporate bonds less attractive to insurers. Our instrument is unlikely to be correlated with the supply of corporate bonds because it is determined by the accumulation of past fiscal deficits. We find that the government debt-to-GDP ratio is indeed a negative and significant predictor of insurer market share, and instrumented market share is a positive and significant predictor of corporate bond maturities. This finding suggests that the variation in insurer market share that is unrelated to the supply side effects influences the maturity of new bond issues, consistent with a demand-side explanation. The economic magnitude of the relationship between instrumented insurer market share and bond maturity in these tests is smaller than what we estimate in our baseline regressions. It appears that uninstrumented insurer market share may also reflect supply side effects.

We conduct additional tests to investigate whether our findings arise from the decline in the demand from insurers. A decline in the market share of insurance companies would lower demand for certain types of bonds (those that insurers prefer) more than others. As the market share of insurers decreases, the issuers of these types of bonds may structure the securities to attract other investors that prefer shorter maturity bonds. Although capital regulations incentivize insurance companies to invest in bonds with safer credit ratings, the evidence is mixed as to whether the maturity decline is more pronounced among investment-grade bonds. When we consider the preferences of insurance companies for many other bond and issuer characteristics in addition to credit ratings, we find that the maturity decline is more pronounced among the bonds that face high demand from insurance companies.

We also investigate how firms benefit from matching with insurance company investors. First, we find that bonds with abnormally low insurance company ownership offer higher yields to issue longer-term bonds. This finding shows that matching with insurance companies lowers the cost of issuing long-term debt. Second, we find that the maturity decline is more pronounced among bonds issued by firms with high information asymmetries. These firms would benefit from issuing shorter maturity bonds to avoid locking in unfavorable rates for a long period of time. Indeed, it appears these firms are forced to issue longer-term bonds in years when insurer market share is high and issue shorter-term bonds as investors who prefer shorter maturity bonds enter the corporate bond market.

Next, we verify the microfoundation of our hypothesis that changes in insurance companies' demand for a bond can have a causal effect on its maturity at issue. We employ a natural experiment: costly natural disasters create acute exogenous shocks to the demand for bonds from insurance companies but not from other investors (Massa and Zhang (2021)). We examine the impact of disaster-induced reductions in demand from insurance companies (particularly property and casualty (P&C) insurers) on the maturity of newly issued bonds. Because most insurance companies offer both P&C and life insurance products, we expect the average bond

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ownership for insurance companies to decline after natural disasters. We find that it indeed does decline, validating the demand shock argument. We then show that bonds with lower levels of insurance company ownership also have shorter maturities. This finding is consistent with the direction of the relationship running from ownership to maturity, offering a foundation for our main results.

Our article contributes to the literature in several ways. Most directly, we provide evidence consistent with a demand-side explanation for the long-term trend in corporate bond maturities. Custódio et al. (2013) find that controlling for the listing year of firms explains the decline in overall corporate debt maturity, but firms' listing years or other characteristics fail to explain the decline in bond maturities. In our article, we show that the change in bond ownership structure is an important driver of the unexplained decline in bond maturities. Accordingly, we provide a clientele-based explanation for the decline in bond maturities over the past 40 years.

This article also contributes to the literature by examining the mechanism driving our results. Just as some investors in equity markets favor certain characteristics, such as geography (Coval and Moskowitz (1999), Massa and Simonov (2006)), dividends (Graham and Kumar (2006)), or tax aspects (Desai and Jin (2011)) in equity securities, we show analogous investor-specific preferences in the fixed income market. Furthermore, by showing that long-term corporate bonds bear lower yields when they are matched with insurer investors, our article documents how bond ownership structure and offering yields are related, adding to the literature on the determinants of bond yields (e.g., Duffee (1998), Collin-Dufresne, Goldstein, and Martin (2001), and Chen, Lesmond, and Wei (2007)).

In addition, our article extends the literature that provides explanations for the time-series variation of corporate debt maturity, such as gap-filling explanations (Greenwood, Hanson, and Stein (2010), Badoer and James (2016)) and explanations based on the shape of the yield curve (Brick and Ravid (1985), Guedes and Opler (1996)). Our findings show that the changing composition of the bond investor base is an additional and important factor that explains the time-series variation in corporate debt maturity. By studying both the market- and bond-level data, our article illustrates the mechanisms and underpinnings of the relationship between insurer market share and bond maturity, and complements the earlier findings that the supply and uncertainty of credit can have real consequences for corporations (e.g., Ellul, Jotikasthira, and Lundblad (2011), Massa, Yasuda, and Zhang (2013)). Our article contributes to this stream of the literature by providing evidence that the type of institutions supplying credit is an important determinant of corporate debt maturity.

II. Data, Sample Selection, and Variables

We construct our sample by combining all U.S. dollar-denominated corporate bonds issued by U.S. industrial firms from the Mergent FISD and SDC New Issues databases.[2] We study industrial firms because the determinants of debt maturity are

[2]The SDC complements the FISD database by contributing 3,636 out of 19,101 bonds in our final sample.

likely to be different across industrial and financial firms due to, for instance, the safety net of explicit or implicit government guarantees for financial firms. We obtain the list of unique bond issues from these databases using their CUSIP numbers. When a CUSIP number is not available, we identify unique bonds using their offering date, maturity date, offering amount, and coupon rate information.

Next, we collect the financial data on the issuers of these bonds using issuer CUSIP and name as identifiers. We obtain the issuers' cumulative monthly stock returns from CRSP during the quarter prior to the bond offering dates and their financial information from COMPUSTAT using their most recent quarterly reports available within a 1-year period before the bond offering dates. Our final sample includes 19,101 bonds issued between 1975 and 2015 by 2,988 firms that have information in the CRSP and COMPUSTAT databases. Our sample period starts in 1975 because the small number of bond issues (fewer than 10 bonds in each year) that satisfy the screening criteria during the earlier years prevents a meaningful comparison of average bond maturities through time.

We compute BOND_MATURITY as the number of years between a bond's maturity date and its issue date. Table 1 reports the summary statistics on the maturity of our bond sample and shows that the mean and median maturities during the entire sample period are 11 years and 10 years, respectively. Graph A of Figure 1 plots the average bond maturity by year. In each year, there are, on average, 466 new bonds issued by 237 firms. The average bond maturity is 21 years in 1975, but it declines to 10 years in 2015. Graph B of Figure 1 compares the maturity of new bonds issued by small and large firms. In each year, we define a firm as large (small) if its market value of equity is above (below) the median market value of equity observed in that year. The decline in bond maturities appears to be similar across large and small issuers.

Following the literature, we construct an extensive list of firm-, bond-, and macro-level control variables to explain bond maturities (e.g., Barclay and Smith (1995), Guedes and Opler (1996), Greenwood et al. (2010), Custódio et al. (2013), and Xu (2018)). The firm-level variables are EQUITY_VALUE, DEBT_TO_ASSETS, INCOME_TO_ASSETS, TANGIBILITY, MARKET_TO_BOOK, STOCK_RETURN, INDUSTRY_DUMMIES, and IPO_DECADE_DUMMIES. We construct EQUITY_VALUE as the stock price at the end of a fiscal quarter multiplied by common shares outstanding, DEBT_TO_ASSETS as the ratio of total debt to total assets, INCOME_TO_ASSETS as the ratio of net income to total assets, TANGIBILITY as the ratio of estimated tangible assets to total assets following Berger, Ofek, and Swary (1996), MARKET_TO_BOOK as the ratio of the market value of assets to book value of assets, STOCK_RETURN as quarterly stock return measured during the 3-month period before the bond offering date, INDUSTRY_DUMMIES based on the Fama–French 12-industry classification, and IPO_DECADE_DUMMIES based on the decade in which a firm first appeared in the CRSP database.

The bond-level variables are OFFERING_AMOUNT, which is the face value of a bond at issue, and a series of dummy variables indicating whether a bond is callable (CALLABLE_DUMMY), has a variable coupon rate (FLOATING_DUMMY), can be converted into equity (CONVERTIBLE_DUMMY), is puttable

TABLE 1

Summary Statistics on Firm-, Bond-, and Macro-Level Variables

Table 1 presents the summary statistics on firm-, bond-, and macro-level variables for our bond sample. To construct our sample, we obtain all U.S. dollar-denominated corporate bonds issued by public U.S. nonfinancial firms between 1975 and 2015 from the Mergent FISD and SDC New Issues databases. Our final sample includes 19,101 unique bonds issued by 2,988 firms with available information in the CRSP and COMPUSTAT databases. See Table IA-1 of the Supplementary Material for variable definitions and data sources.

Variables	*N*	Mean	Median	Std. Dev.
Panel A. Firm-Level Variables				
EQUITY_VALUE (in Billion Dollars)	19,101	16.71	2.81	41.34
MARKET_TO_BOOK	19,101	1.87	1.50	1.78
INCOME_TO_ASSETS	19,101	0.00	0.01	0.40
DEBT_TO_ASSETS	19,101	0.35	0.32	0.27
TANGIBILITY	19,101	0.45	0.46	0.13
STOCK_RETURN	19,101	0.06	0.04	0.24
PRE_1970_IPO_DUMMY	19,101	0.42	0.00	0.49
1970_1979_IPO_DUMMY	19,101	0.13	0.00	0.34
1980_1989_IPO_DUMMY	19,101	0.15	0.00	0.36
1990_1999_IPO_DUMMY	19,101	0.22	0.00	0.42
2000_2010_IPO_DUMMY	19,101	0.06	0.00	0.23
POST_2010_IPO_DUMMY	19,101	0.02	0.00	0.14
NONDURABLES_INDUSTRY_DUMMY	19,101	0.09	0.00	0.28
DURABLES_INDUSTRY_DUMMY	19,101	0.03	0.00	0.18
MANUFACTURING_INDUSTRY_DUMMY	19,101	0.15	0.00	0.36
ENERGY_INDUSTRY_DUMMY	19,101	0.09	0.00	0.29
CHEMICALS_INDUSTRY_DUMMY	19,101	0.09	0.00	0.29
EQUIPMENT_INDUSTRY_DUMMY	19,101	0.12	0.00	0.32
TELECOMMUNICATION_INDUSTRY_DUMMY	19,101	0.07	0.00	0.26
SHOP_INDUSTRY_DUMMY	19,101	0.14	0.00	0.35
HEALTH_INDUSTRY_DUMMY	19,101	0.08	0.00	0.28
OTHER_INDUSTRIES_DUMMY	19,101	0.13	0.00	0.34
Panel B. Bond-Level Variables				
BOND_MATURITY (in Years)	19,101	11.20	9.89	8.78
OFFERING_AMOUNT (in Billion Dollars)	19,101	0.29	0.17	0.43
CALLABLE_DUMMY	19,101	0.62	1.00	0.49
FLOATING_DUMMY	19,101	0.06	0.00	0.24
CONVERTIBLE_DUMMY	19,101	0.17	0.00	0.37
PUTTABLE_DUMMY	19,101	0.07	0.00	0.25
SINKING_FUND_DUMMY	19,101	0.05	0.00	0.22
GLOBAL_ISSUE_DUMMY	19,101	0.11	0.00	0.32
AAA_OR_AA_RATED_DUMMY	19,101	0.07	0.00	0.25
A_RATED_DUMMY	19,101	0.18	0.00	0.38
BBB_RATED_DUMMY	19,101	0.22	0.00	0.41
BB_RATED_DUMMY	19,101	0.09	0.00	0.29
B_OR_BELOW_RATED_DUMMY	19,101	0.19	0.00	0.40
UNRATED_DUMMY	19,101	0.25	0.00	0.43
INSURER_OWNERSHIP	7,337	0.15	0.09	0.17
MUTUAL_FUND_OWNERSHIP	7,337	0.13	0.09	0.13
Panel C. Macro-Level Variables				
INSURER_MARKET_SHARE	19,101	0.30	0.29	0.05
MUTUAL_FUND_MARKET_SHARE	19,101	0.08	0.07	0.04
LONG_GOVERNMENT_DEBT_SHARE	19,101	0.74	0.74	0.03
REAL_SHORT_RATE	19,101	0.03	0.04	0.03
TERM_SPREAD	19,101	0.02	0.02	0.01
DEFAULT_SPREAD	19,101	0.01	0.01	0.00

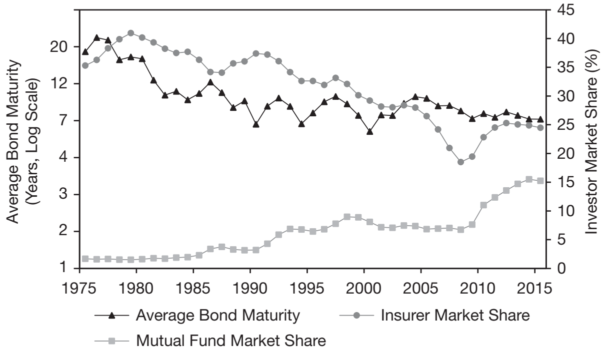
(PUTTABLE_DUMMY), has a sinking fund provision (SINKING_FUND_DUMMY), or is offered simultaneously in countries other than the U.S. (GLOBAL_ISSUE_DUMMY). In addition, we define dummy variables indicating the credit ratings of bonds at issue (RATING_DUMMIES). These dummy variables classify bonds into six credit rating groups (AAA or AA, A, BBB, BB, B or Below, and Unrated) based on the median of rating grades from S&P, Moody's, and Fitch. For example, A_RATED_DUMMY is a dummy variable indicating a bond with an A credit rating (e.g., A+, A, or A− for S&P and Fitch, and A1, A2, or A3 for Moody's).

FIGURE 1

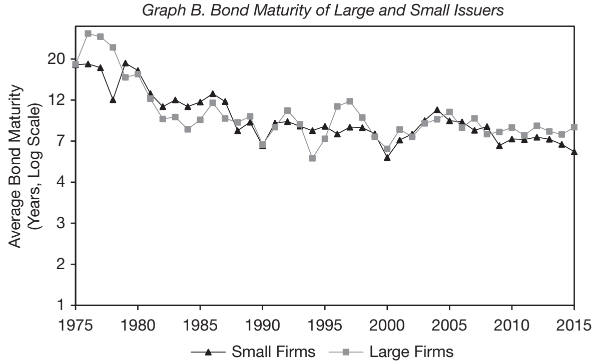
Bond Maturity and Investor Market Share Through Time

Graph A of Figure 1 plots the average of BOND_MATURITY for our sample of 19,101 new bond issues from 1975 to 2015 in log scale, together with the share of insurance company and mutual fund ownership in the U.S. corporate bond market (INSURER_MARKET_SHARE and MUTUAL_FUND_MARKET_SHARE). Graph B plots the logarithm of BOND_MATURITY for new bonds issued by small and large firms. In each year, we define a firm as large (small) if its market value of equity is above (below) the median market value of equity observed in that year. Refer to Table IA-1 of the Supplementary Material for details on variable definitions and data sources and Table 1 for sample selection criteria.

Graph A. Bond Maturity and Market Shares of Insurers and Mutual Funds



Graph B. Bond Maturity of Large and Small Issuers



In addition to the firm- and bond-level variables, we consider four macro-level control variables in our analyses: TERM_SPREAD, DEFAULT_SPREAD, REAL_SHORT_RATE, and LONG_GOVERNMENT_DEBT_SHARE. We construct these macro variables at the end of the calendar quarter prior to bond offering dates. TERM_SPREAD is the difference between the 10-year and 1-year Treasury rates, DEFAULT_SPREAD is the difference between BBB and AAA rated corporate bond yields, REAL_SHORT_RATE is the difference between the 3-month Treasury bill rate and the quarterly percentage change in the Consumer Price Index (CPI), and LONG_GOVERNMENT_DEBT_SHARE is the ratio of the Treasury bond payments due in more than a year to the total Treasury bond payments due in all future periods as defined by Greenwood et al. (2010). We report the data sources for these firm-, bond-, and macro-level control variables along with their detailed definitions in Table IA-1 of the Supplementary Material.

Table 1 presents the summary statistics of the variables used in our baseline regressions. The average (median) bond in our sample is issued by firms with a market capitalization of $17 ($3) billion, market-to-book ratio of 1.9 (1.5), net income-to-assets ratio of 0.3% (1%), leverage ratio of 35% (32%), asset tangibility ratio of 0.45 (0.46), and quarterly stock return of 6% (4%). About 40% of our sample bonds are issued by firms that went public before 1970 and fewer than 10% of our sample bonds are issued by firms that went public after 2000; Table IA-1 of the Supplementary Material provides detailed variable descriptions.

Table 1 reports summary statistics for the market shares of insurance companies and mutual funds, and Graph A of Figure 1 plots their averages by year. The average market shares of insurance companies and mutual funds are 30% and 8%, respectively, but they vary substantially during our analysis period. For instance, insurer market share was 41% in 1979 but it declined to 19% in 2008–2009. The relative market share of insurance companies decreased during our analysis period, possibly because the size of the bond market grew faster than the size of the insurance sector. On the other hand, the market share of mutual funds increased from less than 2% in 1975 to 15% in 2015 due to the tax and retirement policies adopted in the early 1980s that incentivized investments through mutual funds (Rydqvist, Spizman, and Strebulaev (2014)). By plotting both the average maturity and the market shares of insurers and mutual funds, Graph A of Figure 1 allows for a visual comparison of trends in these series and shows that, in the absence of any control variables, bond maturity is positively associated with insurer market share and negatively associated with mutual fund market share.[3]

We also construct bond-level ownerships of insurance companies and mutual funds at the time of bond issuance. Bloomberg compiles the bond holding information of institutional investors from the 13F, Schedule D, 10-K, Form 990, and Form 5500 filings beginning in 1998 at a quarterly frequency.[4] Using this database, we define INSURER_OWNERSHIP (MUTUAL_FUND_OWNERSHIP) as the amount held by insurance companies (mutual funds) measured at the end of the issuance quarter divided by the bond's issue amount. We construct these ownership variables from 1999 to eliminate a potential coverage bias in the database inception year and also perform several quality control checks (e.g., total reported institutional holdings should be less than or equal to the offering amount) to ensure data integrity. We have bond-level institutional investor ownership data for 7,337 bonds. Table 1 shows that the average insurance company (mutual fund) ownership in bonds is 15% (13%) in our subsample of bonds issued between 1999 and 2015.

[3]The other major investors with at least 1% ownership in the U.S. corporate bond market as of 2015 and their ownership shares in 1975 and 2015, respectively, presented in parentheses are: exchange-traded funds (0%, 2.1%), foreign banking offices in the U.S. (0.1%, 1.5%), U.S. government agencies (0%, 1.5%), households and nonprofit organizations (18.8%, 9.7%), other unidentified foreign investors (4.5%, 26.4%), pension funds (30.5%, 10.8%), and U.S.-chartered depository institutions (7.5%, 4.4%).

[4]The Securities and Exchange Commission (SEC) requires all institutional investment managers that exercise investment discretion over $100 million to report its holdings on Form 13f. The National Association of Insurance Commissioners (NAIC) requires all U.S. insurance companies to file Schedule D to reveal their holdings. Form 990 is a document filled with IRS by certain federally tax-exempt organizations. Form 5500 is filed with the Department of Labor by the sponsor of any employee benefit plans subject to Employee Retirement Income Security Act (EIRSA).

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III. Analyses of Maturity Clienteles and Bond Maturities

In this section, we first examine the bond maturity preferences of insurance companies and mutual funds and then test whether accounting for their aggregate ownership shares in the corporate bond market explains the decline in the maturity of new bond issues. We next expand our analyses by implementing alternative empirical approaches to study the relationship between investor ownership shares and bond maturities.

A. The Preferences of Insurers and Mutual Funds for Bond and Issuer Characteristics

We begin our analyses by examining the characteristics of issuers and bonds that are matched with insurance companies and mutual funds. This analysis is the basis for our empirical investigation as it will help us identify the subsample of issuers and bonds that are most likely to be influenced by the changing ownership shares of investors in the corporate bond market. In Section IV, we will use the findings from this section to design additional tests to understand the mechanism driving our findings. The results of this section will also help validate our underlying assumption that insurance companies prefer longer-term bonds and mutual funds prefer shorter-term bonds, controlling for other issuer and bond characteristics.

To study the matching between bonds and investors, we run the following regression separately for insurance company and mutual fund ownerships in bonds using our sample of 7,337 new bond issues with available bond-level ownership data:

$$(1)\quad \text{OWNERSHIP}_i = \alpha + \alpha_t + W'_{jt}\beta + Z'_i\delta + X'_t\gamma + \lambda \log(\text{BOND\_MATURITY}_i) + \varepsilon_i,$$

where OWNERSHIP_i is the percentage of bond i's offering amount held by insurance companies or mutual funds as measured at the end of the offering quarter; α is the intercept; α_t indicates the fixed effects for offering years; W_{jt}, Z_i, and X_t represent issuer-, bond-, and macro-level control variables, respectively; BOND_MATURITY_i is the bond maturity in years; and ε_i is the error term.

The issuer-level control variables (W_{jt}) are log(EQUITY_VALUE), DEBT_TO_ASSETS, INCOME_TO_ASSETS, MARKET_TO_BOOK, TANGIBILITY, STOCK_RETURN, INDUSTRY_FIXED_EFFECTS, and IPO_DECADE_FIXED_EFFECTS; bond-level control variables (Z_i) are log(OFFERING_AMOUNT), CALLABLE_DUMMY, PUTTABLE_DUMMY, FLOATING_DUMMY, CONVERTIBLE_DUMMY, SINKING_FUND_DUMMY, GLOBAL_ISSUE_DUMMY, and RATING_DUMMIES; and the macro-level control variables (X_t) are LONG_GOVERNMENT_DEBT_SHARE, REAL_SHORT_RATE, TERM_SPREAD, and DEFAULT_SPREAD. Section II and Table IA-1 of the Supplementary Material provide detailed definitions of these control variables.

In equation (1), the coefficient on log(BOND_MATURITY) (λ) estimates the relationship between a bond's maturity and a given type of investor's ownership of the bond. We also run regressions with firm fixed effects to examine this relationship within firms. In Section V, we investigate whether there is a causal link running from ownership to maturity.

Column 1 of Table 2 reports the coefficient estimates from equation (1), where the dependent variable is INSURER_OWNERSHIP. We find that the coefficient estimate on log(BOND_MATURITY) is 0.04 and significant, indicating that bond maturity is positively associated with insurance company ownership. This coefficient estimate suggests that a 10% increase in bond maturity (about 1 year for the median bond in our sample) corresponds to a 40 basis points increase in insurance company ownership in bonds. Column 2 of Table 2 shows that the coefficient estimate on log(BOND_MATURITY) remains positive and significant even when we control for firm fixed effects.

The remaining coefficient estimates in column 1 of Table 2 show that bond features other than maturity are also important determinants of insurer ownership. For instance, puttable, floating, and convertible bonds have 9%, 6%, and 5% lower insurer ownership, respectively. Table 2 also shows that bond credit ratings are significant determinants of insurer ownership, suggesting that insurers prefer AAA or AA rated (i.e., AAA, AA+, AA, or AA− rated) bonds over noninvestment-grade (i.e., rated as BB+ or below) and unrated bonds. These findings are robust to including firm fixed effects in column 2 of Table 2. Column 1 of Table 2 also shows that the coefficient estimate on A_RATED_DUMMY is positive and significant, implying that A rated (i.e., A+, A, or A− rated) bonds have greater insurer ownership than AAA or AA rated (i.e., AAA, AA+, AA, or AA− rated) bonds do. Nevertheless, this finding appears to be weak as column 2 reports that the coefficient estimate on A_RATED_DUMMY is insignificant when we control for firm fixed effects. Firm fixed effects seem to pick up some impacts of A_RATED_DUMMY on insurer ownership.[5]

Among the issuer characteristics, DEBT_TO_ASSETS is the only predictor of insurer ownership that is significant both with and without controlling for firm fixed effects. Overall, Table 2 shows that insurance companies prefer bonds that are safer (e.g., investment-grade bonds and low leverage issuers) and have predictable cash flows (e.g., fixed coupon bonds). Controlling for these preferences and a list of other variables, we find a positive relationship between insurer ownership and bond maturity, confirming our assumption that insurance companies prefer long-term bonds.

We next examine the same relationship in the context of mutual funds. Columns 3 and 4 of Table 2 report the coefficient estimates from the regressions of MUTUAL_FUND_OWNERSHIP and show that the coefficient estimate on log(BOND_MATURITY) is −0.01 and significant with and without controlling for firm fixed effects. This coefficient estimate suggests that a 10% increase in bond maturity (about a year for the median bond in our sample) corresponds to a 10 basis points decline in mutual fund ownership. Comparing the magnitude of this estimate

[5]Adding firm fixed effects in Column 2 of Table 2 allows us to investigate the within-firm impacts of the independent variables on insurer ownership and forces identification through changes in the firm's bond rating at the times of at least 2 different issuances. Although this identification approach is useful for partialling out the unmodeled firm fixed characteristics that might affect our results, it also has limitations. Many firms' at-issuance bond ratings do not change drastically through time, so there is not much time-series variation in at-issuance credit ratings within a firm.

TABLE 2

Determinants of Insurer and Mutual Fund Ownership in Bonds

Table 2 reports the results of the regression:

$$\text{OWNERSHIP}_i = \alpha + \alpha_t + W'_{jt}\beta + Z'_i\delta + X'_t\gamma + \lambda \log(\text{BOND\_MATURITY}_i) + \varepsilon_i,$$

where OWNERSHIP$_i$ is INSURER_ or MUTUAL_FUND_OWNERSHIP of bond i; α is the intercept; α_t is year fixed effects; W_{jt}, Z_i, and X_t represent firm-, bond-, and macro-level controls, respectively; and ε_i is the error term. The sample period is 1999–2015 due to the availability of bond ownership data. Firm-level controls (W_{jt}) are log(EQUITY_VALUE), DEBT_TO_ASSETS, INCOME_TO_ASSETS, MARKET_TO_BOOK, TANGIBILITY, and STOCK_RETURN. Bond-level controls (Z_i) are log(OFFERING_AMOUNT), CALLABLE_DUMMY, FLOATING_DUMMY, CONVERTIBLE_DUMMY, PUTTABLE_DUMMY, SINKING_FUND_DUMMY, GLOBAL_ISSUE_DUMMY, A_RATED_DUMMY, BBB_RATED_DUMMY, BB_RATED_DUMMY, B_OR_BELOW_RATED_DUMMY, and UNRATED_DUMMY. Macro-level controls (X_t) are LONG_GOVERNMENT_DEBT_SHARE, REAL_SHORT_RATE, TERM_SPREAD, and DEFAULT_SPREAD. Refer to Table IA-1 of the Supplementary Material for variable definitions and Table 1 for sample selection criteria. Standard errors used to compute t-statistics in parentheses are clustered at the firm level. ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively.

	Dependent Variable			
	INSURER_OWNERSHIP		MUTUAL_FUND_OWNERSHIP	
Control Variables	1	2	3	4
log(BOND_MATURITY)	0.04***	0.03***	−0.01***	−0.01***
	(9.87)	(8.73)	(−4.63)	(−5.24)
log(OFFERING_AMOUNT)	0.01	−0.01	0.01***	0.01***
	(1.18)	(−0.76)	(3.63)	(2.99)
CALLABLE_DUMMY	0.02***	0.02***	−0.01	−0.01
	(2.63)	(3.50)	(−0.80)	(−1.35)
PUTTABLE_DUMMY	−0.09***	−0.10***	0.01	0.02*
	(−10.92)	(−9.52)	(1.51)	(1.77)
FLOATING_DUMMY	−0.06***	−0.07***	−0.01	−0.01
	(−8.17)	(−9.31)	(−1.39)	(−0.85)
CONVERTIBLE_DUMMY	−0.05***	−0.06***	−0.02***	−0.02**
	(−6.81)	(−7.00)	(−2.88)	(−1.98)
SINKING_FUND_DUMMY	0.11	0.21*	−0.01	−0.01
	(0.80)	(1.72)	(−0.53)	(−0.55)
GLOBAL_ISSUE_DUMMY	0.02**	0.02**	−0.01**	−0.01
	(2.15)	(2.37)	(−2.07)	(−0.85)
A_RATED_DUMMY	0.04**	0.02	0.01	−0.01
	(2.12)	(1.24)	(1.08)	(−0.75)
BBB_RATED_DUMMY	0.02	0.00	0.04***	−0.00
	(0.97)	(0.15)	(3.55)	(−0.20)
BB_RATED_DUMMY	−0.14***	−0.13***	0.14***	0.08***
	(−5.91)	(−5.35)	(11.08)	(3.87)
B_OR_BELOW_RATED_DUMMY	−0.20***	−0.16***	0.15***	0.10***
	(−7.91)	(−6.42)	(11.23)	(4.83)
UNRATED_DUMMY	−0.17***	−0.11***	0.10***	0.03
	(−6.74)	(−4.34)	(6.11)	(1.41)
log(EQUITY_VALUE)	−0.02***	0.01	0.00	−0.01
	(−5.18)	(1.23)	(0.82)	(−1.60)
DEBT_TO_ASSETS	−0.04***	−0.07***	0.00	0.00
	(−3.48)	(−4.86)	(0.35)	(0.01)
INCOME_TO_ASSETS	0.05	−0.00	0.00	0.04
	(1.44)	(−0.04)	(0.11)	(0.68)
MARKET_TO_BOOK	0.00***	0.00	0.00*	0.00*
	(3.13)	(1.43)	(1.90)	(1.83)
TANGIBILITY	−0.03*	−0.02	−0.02	−0.02
	(−1.77)	(−0.74)	(−1.24)	(−0.60)
STOCK_RETURN	−0.01**	−0.01*	0.01	0.01
	(−2.04)	(−1.73)	(1.12)	(0.97)
No. of obs.	7,337	7,337	7,337	7,337
Adj. R^2 (%)	43.28	25.7	40.4	23.96
Firm fixed effects	No	Yes	No	Yes
Industry fixed effects	Yes	No	Yes	No
Firm IPO decade fixed effects	Yes	No	Yes	No
Macro-level controls	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes

to those from regressions of insurer ownership in columns 1 and 2, we observe that the mutual fund preference for shorter maturity bonds is economically smaller than the insurer preference for longer maturity bonds. This result could be because some mutual funds have the objective of investing in long duration bonds.

Table 2 also shows that bond credit ratings are important determinants of mutual fund ownership. Unlike insurance companies, however, mutual funds invest more in riskier bonds. Among the remaining issue and issuer characteristics, we find that log(OFFERING_AMOUNT) and CONVERTIBLE_DUMMY are the only bond features that are economically and statistically significant predictors of mutual fund ownership with and without controlling for firm fixed effects. Accordingly, mutual funds appear to prefer larger bond issues and nonconvertible bonds.

Our results in this section illustrate the heterogeneous investor preferences in the corporate bond market. In summary, insurance companies invest more in longer-term, safer, and fixed coupon bonds. In contrast, mutual funds invest more in shorter-term and riskier bonds. Both insurance companies and mutual funds tend to avoid convertible bonds. In the next section, we test our hypothesis that a decrease (an increase) in the market share of insurers (mutual funds) in the corporate bond market is associated with a decrease in bond maturities, and in Section VI.A, we test an alternative explanation that the changes in the characteristics of issuers or bonds in the corporate bond market drive the decrease in bond maturities.

B. The Influence of Insurer and Mutual Fund Market Shares on the Bond Maturity Trend

In this section, we study whether the changes in the market shares of insurance companies and mutual funds can explain the decline in corporate bond maturities. We run the following regression for our sample of 19,101 bond issues during the 1975–2015 period:

$$\text{(2)} \quad \log(\text{BOND\_MATURITY}_i) = \begin{array}{l} \alpha + W'_{jt}\beta + Z'_i\delta + X'_t\gamma + \tau\text{TREND}_t \\ + \theta\text{INVESTOR\_MARKET\_SHARE}_t + \varepsilon_i. \end{array}$$

This regression equation is similar to equation (1) except that its dependent variable is log(BOND_MATURITY$_i$) and it includes TREND$_t$ and INVESTOR_MARKET_SHARE$_t$ as additional regressors. TREND$_t$ is the difference between the year of bond issuance and the year our sample period starts (1975), and INVESTOR_MARKET_SHARE$_t$ is the aggregate ownership share of insurance companies or mutual funds in the U.S. corporate bond market (see Table IA-1 of the Supplementary Material for detailed variable definitions). We estimate this regression with and without controlling for market shares of investors to see whether they explain the maturity decline.

Column 1 of Table 3 reports the coefficient estimate on TREND from this ordinary least squares (OLS) regression of bond maturity without controlling for market shares of investors. We find that the coefficient estimate on TREND (multiplied by 100) is −1.12 and significant, indicating a 1.12%, or 1.5 months, unexplained decline in bond maturity each year. This amount is equivalent to a total unexplained decline of 5 years during the sample period, which is about half of that

TABLE 3

The Relation Between Investor Market Share and Bond Maturity

Table 3 investigates the relation between the share of investor ownership in the corporate bond market (i.e., INSURER_MARKET_SHARE and MUTUAL_FUND_MARKET_SHARE) and BOND_MATURITY. We estimate: $\log(\text{BOND\_MATURITY}_i) = \alpha + W'_{jt}\beta + Z'_i\delta + X'_t\gamma + \tau\text{TREND}_t + \theta\text{INVESTOR\_MARKE\_SHARE}_t + \varepsilon_i$, where α is the intercept; W_{jt}, Z_i, and X_t represent firm-, bond-, and macro-level control variables, respectively; TREND_t is the difference between the year of bond issuance and the year when our sample period starts (1975); INVESTOR_MARKET_SHARE is the share of insurance company or mutual fund ownership in the U.S. corporate bond market; and ε_i is the error term. Refer to Table 1 for sample selection criteria, Table 2 for the list of firm-, bond-, and macro-level control variables, and Table IA-1 of the Supplementary Material for variable definitions and data sources. Standard errors used to compute *t*-statistics in parentheses are clustered at the firm level. ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively.

	Dependent Variable: log(BOND_MATURITY)											
Model	Maturity Trend		Insurer Market Share				Mutual Fund Market Share				Insurer and Mutual Fund Market Share	
Control Variables	1	2	3	4	5	6	7	8	9	10	11	12
TREND × 100	−1.12***	−0.85***	–	–	−0.10	0.21	–	–	−1.23***	−0.91***	0.17	0.59
	(−5.35)	(−3.04)	–	–	(−0.34)	(0.61)	–	–	(−5.32)	(−2.60)	(0.43)	(1.24)
INSURER_MARKET_SHARE	–	–	1.91***	1.67***	1.80***	1.86***	–	–	–	–	2.00***	2.12***
	–	–	(6.99)	(4.53)	(4.64)	(4.05)	–	–	–	–	(4.30)	(4.07)
MUTUAL_FUND_MARKET_SHARE	–	–	–	–	–	–	−1.16**	−0.76	0.46	0.26	−0.63	−0.90
	–	–	–	–	–	–	(−2.38)	(−1.32)	(0.84)	(0.35)	(−1.00)	(−1.14)
No. of obs.	19,101	19,101	19,101	19,101	19,101	19,101	19,101	19,101	19,101	19,101	19,101	19,101
Adj. R^2 (%)	22.19	17.27	22.36	17.45	22.36	17.45	21.95	17.17	22.19	17.27	22.36	17.46
Firm fixed effects	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Industry fixed effects	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Firm IPO decade fixed effects	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Firm-level controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bond-level controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Macro-level controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

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reported in Custódio et al. (2013). Hence, although our comprehensive set of firm-, bond-, and macro-level covariates improve the explanatory power of the existing model, it still fails to explain fully the substantial decline in bond maturities observed since the 1970s. Column 2 reports that the coefficient estimate on TREND maintains its sign and significance controlling for firm fixed effects, showing that the declining trend in bond maturities also persists within firms.

Next, we exclude TREND from our maturity regression and include INSURER_MARKET_SHARE as an additional regressor. Columns 3 and 4 of Table 3, respectively, report that the coefficient estimate on INSURER_MARKET_SHARE is 1.91 in the OLS model and 1.67 in the fixed effects model. Both of these coefficient estimates are statistically significant at the 1% level and suggest that a 10 percentage point increase in INSURER_MARKET_SHARE is associated with an 18% to 21% increase in bond maturity. Hence, consistent with insurers' preference for longer-term bonds, bond maturity is positively related to the share of insurance company ownership in the corporate bond market.

We then include both TREND and INSURER_MARKET_SHARE variables in our maturity regression to examine the relationship between the market share of insurance companies and the unexplained maturity decline. Columns 5 and 6 of Table 3 report that the coefficient estimate on TREND becomes indistinguishable from zero after controlling for INSURER_MARKET_SHARE in both OLS and fixed effects specifications. Therefore, the decline in insurance companies' share in the corporate bond market explains a significant part of the decline in bond maturities observed since the 1970s that is unexplained by a battery of firm-, bond-, and macro-level controls.

We investigate the relationship between mutual fund market share and bond maturities by rerunning the regressions in columns 3–6 of Table 3 controlling for MUTUAL_FUND_MARKET_SHARE instead of INSURER_MARKET_SHARE. Column 7 of Table 3 reports the results from the OLS specification and shows that the coefficient estimate on MUTUAL_FUND_MARKET_SHARE is negative (−1.16) and significant at the 5% level, suggesting that a 10% increase in MUTUAL_FUND_MARKET_SHARE is associated with an 11% decrease in bond maturity. However, column 8 shows that the coefficient estimate on MUTUAL_FUND_MARKET_SHARE becomes insignificant when controlling for firm fixed effects. Columns 9 and 10 respectively report the results from OLS and firm fixed effects regressions that control for both TREND and MUTUAL_FUND_MARKET_SHARE, and show that the weak association of mutual fund market share with bond maturity is insufficient to explain the maturity decline.

Finally, we include TREND, INSURER_MARKET_SHARE, and MUTUAL_FUND_MARKET_SHARE variables altogether as additional controls in our maturity regression and report the results from OLS and fixed effects specifications in columns 11 and 12 of Table 3, respectively. We find in both specifications that the coefficient estimates on INSURER_MARKET_SHARE are positive and significant and those on TREND and MUTUAL_FUND_MARKET_SHARE are insignificant. These results show that the declining share of insurance company ownership in the corporate bond market is strongly correlated with the decline in bond maturities that is unexplained by the known determinants of debt maturity.

In the following subsections, we dig deeper into this relationship by investigating whether insurer market share Granger causes bond maturity (Section III.C) and examining the causality of this relationship by implementing an instrumental variable approach (Section III.D).

C. Granger Causality Test of Bond Maturity and Insurer Market Share

As insurance companies prefer investing in long-term bonds, the positive relation between insurer market share and bond maturity may be due to changes in the supply of long-term corporate bonds instead of changes in the demand for long-term corporate bonds from insurance companies. Accordingly, a decline in the supply of long-term bonds may lead to a decline in insurer market share rather than the other way around. We run a Granger causality test to examine the direction of the relationship between the insurer market share and bond maturity in the aggregate.

To construct the data for this test, we first compute the weighted average of log(BOND_MATURITY) in each year from 1975 to 2015, where the weights are based on the issue amounts of bonds. Next, we match this maturity series with INSURER_MARKET_SHARE observed at the end of each year. Before implementing the Granger causality test, we calculate the Akaike Information Criterion (AIC) for the two series and find that the optimum number of lags to control in our regressions is 2. We then run an Augmented Dickey–Fuller (ADF) test on the two series to see whether they are stationary and report the test results in Table 4. Because the two series are on a time trend, we run the ADF test with trend adjustment and find that both series are stationary when controlling for their two lags. Considering these findings, we implement a Granger causality test using a vector autoregression (VAR) model and controlling for two lags of the series and the time trend.

Columns 1 and 2 of Table 4 report the VAR results for AVERAGE_log (BOND_MATURITY) and INSURER_MARKET_SHARE, respectively. We find that lagged INSURER_MARKET_SHARE is a positive and significant predictor of AVERAGE_log(BOND_MATURITY), but lagged AVERAGE_log(BOND_MATURITY) is an insignificant predictor of INSURER_MARKET_SHARE. The Wald statistics reported in Table 4 further confirm that the direction of causality goes from INSURER_MARKET_SHARE to AVERAGE_log(BOND_MATURITY) and not vice versa. These findings suggest that insurer market share Granger causes bond maturity in the aggregate.

D. Instrumenting for Insurer Market Share

The market share of insurance companies reflects both the insurer demand for corporate bonds and the supply of corporate bonds. For instance, Baghai et al. (2014) show that credit rating agencies have become more conservative over time, leading to fewer bonds issued by investment-grade firms that insurance companies prefer. Accordingly, a decline in INSURER_MARKET_SHARE may be driven by the decline in the supply of bonds with high creditworthiness. To isolate this supply side effect from our analyses and establish a causal relationship between insurers' demand for bonds and bond maturity, we use an instrumental variable approach in

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TABLE 4

Granger Causality Test of Insurer Market Share and Bond Maturity

Table 4 reports the results from a Granger causality test of INSURER_MARKET_SHARE and BOND_MATURITY based on a vector autoregression (VAR) model. To construct the data for this test, we first compute the offering amount weighted average log(BOND_MATURITY) in each year between 1975 and 2015 for our sample of 19,101 new bond issues. We next match this annual maturity series with INSURER_MARKET_SHARE at the end of each year. The dependent variable in the regressions reported in columns 1 and 2 is AVERAGE_log(BOND_MATURITY) and INSURER_MARKET_SHARE, respectively. This table also reports the augmented Dickey–Fuller test statistics and the Wald test statistics for AVERAGE_log(BOND_MATURITY) and INSURER_MARKET_SHARE. Refer to Table IA-1 of the Supplementary Material for the variable definitions and data sources and Table 1 for sample selection criteria. *Z*-statistics are reported in parentheses. ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively.

	Dependent Variable	
	AVERAGE_log(BOND_MATURITY)	INSURER_MARKET_SHARE
Control Variables	1	2
AVERAGE_log(BOND_MATURITY)$_{t-1}$	0.50***	0.01
	(3.48)	(0.62)
AVERAGE_log(BOND_MATURITY)$_{t-2}$	0.15	−0.02
	(1.04)	(−1.19)
INSURER_MARKET_SHARE$_{t-1}$	2.43*	1.23***
	(1.81)	(9.21)
INSURER_MARKET_SHARE$_{t-2}$	−3.05**	−0.54***
	(−2.32)	(−4.13)
TREND × 100	−0.71	−0.17***
	(−1.20)	(−2.96)
INTERCEPT	1.20**	0.15***
	(2.07)	(2.68)
No. of obs.	39	39
Augmented Dickey–Fuller Test (*p*-value)		
INSURER_MARKET_SHARE	0.06	–
AVERAGE_log(BOND_MATURITY)	0.07	–
Granger Causality Wald Test (*p*-value)		
INSURER_MARKET_SHARE Predicts AVERAGE_log(BOND_MATURITY)	0.07	–
AVERAGE_log(BOND_MATURITY) Predicts INSURER_MARKET_SHARE	0.47	–

which we instrument for INSURER_MARKET_SHARE in our baseline regression of bond maturity (column 4 of Table 3).

Krishnamurthy and Vissing-Jorgensen (2012) show that the yield of Treasury bonds, relative to that of corporate bonds, increases as the supply of government debt, proxied by the government debt-to-GDP ratio, increases. Insurance companies, due to their natural demand for safe financial assets, have a stronger preference for Treasury bonds. When the government supplies more debt, the relative increase in the yield of Treasury bonds may attract more insurer investors from the corporate to the Treasury bond market. We define GOVERNMENT_DEBT_TO_GDP as the ratio of total public debt outstanding to gross domestic product (GDP) of the U.S. We obtain these variables from Bloomberg in quarterly frequency. As this ratio reflects the accumulation of past fiscal deficits, it is unlikely to be correlated with the concurrent supply of investment-grade corporate bonds. Therefore, it plausibly satisfies the exclusion condition to be a valid instrument for INSURER_MARKET_SHARE in the regression of corporate bond maturity.

Because bond-level variables and INSURER_MARKET_SHARE are measured at different times, we first estimate the part of log(BOND_MATURITY) unexplained by the control variables other than INSURER_MARKET_SHARE and then run a 2SLS regression of UNEXPLAINED_log(BOND_MATURITY) controlling only for INSURER_MARKET_SHARE. UNEXPLAINED_log (BOND_MATURITY) is the fitted error term ($\widehat{\varepsilon_i}$) from the following regression:

$$(3) \qquad \log(\text{BOND\_MATURITY}_i) = \alpha + \alpha_i + W'_{jt}\beta + Z'_i\delta + X'_t\gamma + \varepsilon_i,$$

where α is the intercept; α_i is the firm fixed effect; W_{jt}, Z_i, and X_t represent firm-, bond-, and macro-level control variables, respectively; and ε_i is the error term. The control variables are the same as those used in equation (1). As this equation controls for LONG_GOVERNMENT_DEBT_SHARE, our orthogonalization alleviates the concern that GOVERNMENT_DEBT_TO_GDP is positively correlated with government debt maturity (Krishnamurthy and Vissing-Jorgensen (2012)), which may influence firms' bond maturity choices according to Greenwood et al. (2010).

Column 1 of Table 5 shows that GOVERNMENT_DEBT_TO_GDP is a strong and negative predictor of INSURER_MARKET_SHARE: a 10 percentage point increase in GOVERNMENT_DEBT_TO_GDP ratio is associated with a 2% decrease in INSURER_MARKET_SHARE. The F-statistic for a weak instrument test from the first stage regression is 3,860. This large F-statistic might be driven by the fact that the dependent variable (i.e., INSURER_MARKET_SHARE) and the instrumental variable (i.e., GOVERNMENT_DEBT_TO_GDP) are macro

TABLE 5

Instrumenting for Insurer Market Share

Table 5 reports the results from regressions that instrument INSURER_MARKET_SHARE in the baseline model (column 4 of Table 3) of corporate bond maturities. Directly instrumenting INSURER_MARKET_SHARE using a 2-stage least square (2SLS) model is problematic because some control variables in the first stage regression of INSURER_MARKET_SHARE are measured after INSURER_MARKET_SHARE has been observed, which might introduce forward-looking biases to the estimation. To address this issue, we first estimate the part of log(BOND_MATURITY) unexplained by the control variables other than INSURER_MARKET_SHARE and then run a 2SLS regression of UNEXPLAINED_log(BOND_MATURITY) on INSURER_MARKET_SHARE. UNEXPLAINED_log(BOND_MATURITY) is the fitted error term ($\widehat{\varepsilon_i}$) from the following regression:

$$\log(\text{BOND\_MATURITY}_i) = \alpha + \alpha_i + W'_{jt}\beta + Z'_i\delta + X'_t\gamma + \epsilon_i,$$

where α is the intercept; α_i is the firm fixed effect; W_{jt}, Z_i, and X_t represent firm-, bond-, and macro-level control variables, respectively; and ε_i is the error term. We then run a 2SLS regression of UNEXPLAINED_log(BOND_MATURITY) using GOVERNMENT_DEBT_TO_GDP as an instrument for INSURER_MARKET_SHARE. We report the first- and second-stage regression results in columns 1 and 2, respectively. In these columns, standard errors used to compute t-statistics in parentheses are clustered at the firm level. We also run a 2SLS regression using quarterly time-series data where the dependent variable is quarterly AVERAGE_UNEXPLAINED_log(BOND_MATURITY) and report the first and second stage regression results in columns 3 and 4, respectively. Refer to Table 1 for sample selection criteria, Table 2 for the list of firm-, bond-, and macro-level control variables, and Table IA-1 of the Supplementary Material for variable definitions and data sources. ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively.

Sample	Panel Data Set		Time-Series Data Set	
Regression	First Stage	Second Stage	First Stage	Second Stage
Dependent Variable	INSURER_ MARKET_SHARE	UNEXPLAINED_log (BOND_MATURITY)	INSURER_ MARKET_SHARE	AVERAGE_UNEXPLAINED_ log(BOND_MATURITY)
Control Variables	1	2	3	4
GOVERNMENT_ DEBT_TO_GDP	−0.19***	–	−0.23***	–
	(−62.14)	–	(−20.79)	–
Instrumented INSURER_ MARKET_SHARE	–	0.84***	–	0.84***
	–	(2.62)	–	(3.44)
F-Test for weak instrumental variable	3,860.79***		432.22***	
No. of obs.	19,101	19,101	164	164
Adj. R^2 (%)	44.99	0.73	60.17	9.30

variables that are duplicated for bonds issued in the same quarter. To address this concern, we also run this instrumental variable regression using quarterly average time-series data. Column 3 of Table 5 reports that the F-statistic from the first stage regression of this time-series approach is 432. Based on these F-statistics, GOVERNMENT_DEBT_TO_GDP does not appear to be a weak instrument for INSURER_MARKET_SHARE.

Columns 2 and 4 of Table 5 report the results from the second stage regressions using the panel and time-series approaches, respectively, and show that instrumented INSURER_MARKET_SHARE is a positive and significant predictor of corporate bond maturity. However, we observe that instrumenting for INSURER_MARKET_SHARE reduces its coefficient estimate from 1.67 in the baseline model (column 4 of Table 3) to 0.84, suggesting that a part of the insurer market share may reflect the supply side effects in corporate bond offerings discussed previously.

The findings in this section provide evidence that changes in insurer demand for bonds can indeed affect the maturity of new bond issues. However, they also suggest that INSURER_MARKET_SHARE reflects the interaction between supply and demand side effects for corporate bonds.

IV. The Mechanism Driving the Findings

In this section, we run several tests to understand whether our findings are driven by the decline in demand for long-term bonds from insurance companies. We first investigate if the decline in bond maturities varies predictably based on bond and insurance company characteristics that are related to the maturity preferences of insurance companies and then examine how issuers benefit from matching with insurance companies.

A. The Maturity Trend Within Investment-Grade Bonds

If the decline in bond maturities is associated with the decline in insurance company ownership, this relationship should be more pronounced among bonds whose primary investors are insurance companies. Risk-based capital regulations encourage insurance companies to purchase investment-grade bonds (e.g., Webb and Lilly (1994)). Table 6 shows that there is a significant declining trend in maturities among investment-grade bonds (columns 1–2). The declining trend becomes insignificant after controlling for INSURER_MARKET_SHARE (columns 3–4), and INSURER_MARKET_SHARE maintains its significance when including MUTUAL_FUND_MARKET_SHARE as an additional control (columns 5–6). We find mixed evidence about whether the declining maturity trend among investment-grade bonds is more pronounced than the average declining trend for all the bonds reported in columns 1–2 of Table 3. Specifically, without controlling for firm fixed effects, the coefficient estimate on TREND is −0.78 in column 1 of Table 6 and −1.12 in column 1 of Table 3. On the other hand, controlling for firm fixed effects, the coefficient estimate on TREND is −0.95 in column 2 of Table 6 and − 0.85 in column 1 of Table 3.

TABLE 6

Insurer Market Share and the Decline in Investment-Grade Bond Maturities

Table 6 investigates the relation between INSURER_MARKET_SHARE and BOND_MATURITY within a subsample of investment-grade bonds. The regression model is:

$$\log(\text{BOND\_MATURITY}_i) = \alpha + W'_{jt}\beta + Z'_i\delta + X'_t\gamma + \tau\text{TREND}_t + \theta\text{INSURER\_MARKET\_SHARE}_t + \epsilon_i,$$

where α is the intercept; W_{jt}, Z_i, and X_t represent firm-, bond-, and macro-level control variables, respectively; TREND_t is the difference between the year of bond issuance and the year when our sample period starts (1975); $\text{INSURER\_MARKET\_SHARE}_t$ is the share of insurance company ownership in the U.S. corporate bond market; and ε_i is the error term. Columns 5 and 6 include MUTUAL_FUND_MARKET_SHARE as an additional control variable. MUTUAL_FUND_MARKET_SHARE is the share of mutual fund ownership in the U.S. corporate bond market. Refer to Table 1 for sample selection criteria, Table 2 for the list of firm-, bond-, and macro-level control variables, and Table IA-1 of the Supplementary Material for variable definitions and data sources. Standard errors used to compute *t*-statistics in parentheses are clustered at the firm level. ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively.

	Dependent Variable: log(BOND_MATURITY)					
Control Variables	1	2	3	4	5	6
TREND × 100	−0.78**	−0.95**	0.19	−0.09	0.39	0.27
	(−1.98)	(−2.18)	(0.37)	(−0.20)	(0.66)	(0.45)
INSURER_MARKET_SHARE	–	–	1.66***	1.47***	1.81***	1.74**
	–	–	(2.87)	(2.46)	(2.60)	(2.34)
MUTUAL_FUND_MARKET_SHARE	–	–	–	–	−0.45	−0.84
	–	–	–	–	(−0.51)	(−0.85)
No. of obs.	8,846	8,846	8,846	8,846	8,846	8,846
Adj. R^2 (%)	23.38	19.27	23.47	19.34	23.47	19.34
Firm fixed effects	No	Yes	No	Yes	No	Yes
Industry fixed effects	Yes	No	Yes	No	Yes	No
Firm IPO decade fixed effects	Yes	No	Yes	No	Yes	No
Firm-level controls	Yes	Yes	Yes	Yes	Yes	Yes
Bond-level controls	Yes	Yes	Yes	Yes	Yes	Yes
Macro-level controls	Yes	Yes	Yes	Yes	Yes	Yes

A potential explanation for this mixed result could be that, as we discuss in Section III.A, bond characteristics other than credit ratings also play an important role in explaining insurance company ownership in bonds. We conduct additional tests in the next section to take these factors into account.

B. Insurance Companies' Preferences and the Decline in Bond Maturities

To identify the bonds that insurance companies prefer, we predict insurance company ownership for all the 19,101 bonds in our sample. Specifically, we first use the subsample of 7,337 bonds with available bond-level ownership information between 1999 and 2015 to estimate equation (1) without controlling for log(BOND_MATURITY). We also exclude year and firm fixed effects from the regression because we use the coefficient estimates to predict insurance company ownerships for the entire sample of bonds issued between 1975 and 2015. As our model controls for the macro-level variables (e.g., default and term spreads), the predicted ownerships take the state-dependent risk preferences of insurance companies into account. We then classify each bond into high or low insurance company demand subsamples based on whether its predicted insurance company ownership is above or below the sample's median of 11.98%.

Columns 1–2 and 3–4 of Table 7 report the coefficient estimates from the regression of log(BOND_MATURITY) for the high and low insurance company demand subsamples, respectively. The coefficient estimate on TREND is negative

TABLE 7

Insurer Preferences and the Decline in Bond Maturities

Table 7 investigates whether the decline in bond maturity varies with the preferences of insurers. The regression model is $\log(\text{BOND\_MATURITY}_i) = \alpha + W'_{jt}\beta + Z'_i\delta + X'_t\gamma + \tau\text{TREND}_t + \varepsilon_i$, where BOND_MATURITY$_i$ is the maturity of bond i; α is the intercept; W_{jt}, Z_i, and X_t represent firm-, bond-, and macro-level controls, respectively; TREND$_t$ is the difference between the year of bond issuance and the year when our sample period starts (1975); and ε_i is the error term. Columns 1–2 and 3–4 report the regression results using subsamples of bonds that face high and low demand from insurance companies, respectively. To determine insurance company demand, we first regress bond-level insurance company ownership on the control variables in our baseline analysis (see Table 2 for details). Based on the regression estimates, we predict insurance company ownership for the entire sample of 19,101 bonds. Then, we classify each bond into a high or low insurance company demand subsample based on whether its predicted insurance company ownership is above or below the sample's median. Refer to Table 1 for sample selection criteria, Table 2 for the list of firm-, bond-, and macro-level control variables, and Table IA-1 of the Supplementary Material for variable definitions and data sources. Standard errors used to compute t-statistics are clustered at the firm level. ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively.

	Dependent Variable: log(BOND_MATURITY)			
Model	High Demand		Low Demand	
Control Variables	1	2	3	4
TREND × 100	−1.23***	−1.41***	−0.38	−0.06
	(−3.71)	(−3.91)	(−1.45)	(−0.15)
No. of obs.	9,550	9,550	9,551	9,551
Adj. R^2 (%)	22.45	16.18	25.46	16.97
Chi-square test for the difference in TREND coefficients				
	(1) versus (3)		(2) versus (4)	
	4.85**		7.25***	
Firm fixed effects	No	Yes	No	Yes
Industry fixed effects	Yes	No	Yes	No
Firm IPO decade fixed effects	Yes	No	Yes	No
Firm-level controls	Yes	Yes	Yes	Yes
Bond-level controls	Yes	Yes	Yes	Yes
Macro-level controls	Yes	Yes	Yes	Yes

and significant for the high insurance company demand subsample, and it is negative but insignificant for the low insurance company demand subsample. The difference in these coefficient estimates is statistically significant, indicating that the decline in bond maturity is indeed more pronounced for the subsample of bonds that face high demand from insurance companies.

C. Maturity Trend Within Bonds That Are Marginal Matches for Insurers

The demand channel predicts that insurance companies allocate their investments based on their order of preferences for issuer or bond characteristics. Accordingly, bonds that are best matches for insurers (i.e., ranked highest in the preference list) can be issued in longer maturities even when the insurer market share is low. By the same token, we do not expect bonds that are ranked low in the preference list to be affected by the decline in the insurer market. Consistent with this hypothesis, columns 3–4 of Table 7 show that the declining maturity trend is insignificant among low insurer demand bonds. On the other hand, bonds that are marginal matches for insurers might be offered in longer maturities during the 1970s when insurer market share was high but offered in shorter maturities when insurer market share declined during the later periods. For these types of bonds, the decline in insurer market share would be binding. Accordingly, we expect the declining maturity trend to be the most significant among the bonds that are "marginal matches" for insurers.

TABLE 8

The Maturity Trend Within Terciles of High Insurer Demand Bonds

Table 8 investigates whether the declining maturity trend is more pronounced for bonds that are marginal matches with insurance companies. The regression model is:

$$\log(\text{BOND\_MATURITY}_i) = \alpha + W_{jt}'\beta + Z_i'\delta + X_t'\gamma + \tau \text{TREND}_t + \epsilon_i,$$

where BOND_MATURITY_i is the maturity of bond i; α is the intercept; W_{jt}, Z_i, and X_t represent firm-, bond-, and macro-level controls, respectively; TREND_t is the difference between the year of bond issuance and the year when our sample period starts (1975); and ε_i is the error term. As in columns 1–2 of Table 7, we first classify the bonds with above-median predicted insurer ownership as facing high demand from insurers. We then split this subsample into terciles based on their predicted level of insurer ownership. Columns 1–2, 3–4, and 5–6 report the regression results using bonds ranked in the lowest, middle, and highest terciles of predicted insurer ownerships, respectively, within high insurer demand bonds. Refer to Table 1 for sample selection criteria, Table 2 for the list of firm-, bond-, and macro-level control variables, and Table IA-1 of the Supplementary Material for variable definitions and data sources. Standard errors used to compute t-statistics are clustered at the firm level. ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively.

	Dependent Variable: log(BOND_MATURITY)					
Model	Lowest Tercile High Demand Bonds		Middle Tercile High Demand Bonds		Highest Tercile High Demand Bonds	
Control Variables	1	2	3	4	5	6
TREND × 100	−2.19***	−1.87***	−1.08**	−0.66	−1.23***	−0.78
	(−4.63)	(−2.64)	(−2.26)	(−1.00)	(−3.36)	(−1.53)
No. of obs.	3,184	3,184	3,183	3,183	3,183	3,183
Adj. R^2 (%)	30.45	16.93	12.10	6.06	24.62	13.63
Chi-square test for the difference in TREND coefficients						
	(1) versus (3)		(2) versus (4)	(3) versus (5)	(4) versus (6)	
	3.69*		2.02	0.07	0.02	
Firm fixed effects	No	Yes	No	Yes	No	Yes
Industry fixed effects	Yes	No	Yes	No	Yes	No
Firm IPO decade fixed effects	Yes	No	Yes	No	Yes	No
Firm-level controls	Yes	Yes	Yes	Yes	Yes	Yes
Bond-level controls	Yes	Yes	Yes	Yes	Yes	Yes
Macro-level controls	Yes	Yes	Yes	Yes	Yes	Yes

To test this prediction, we further split the subsample of "High Insurance Demand" bonds in columns 1–2 of Table 7 into terciles based on the predicted insurance company ownership, and label the bonds in the lowest tercile as "marginal matches" for insurance companies. Columns 1–2 of Table 8 estimate the declining trend in maturities among these marginally matched bonds. The coefficient estimate on TREND is −2.19 and −1.87 in the OLS and fixed effects models, respectively. The magnitudes of these coefficients are about twice as large as those estimated using the bonds that are better matches for insurers (columns 3–6 of Table 8), and they are also greater than those reported in our baseline regressions (columns 1–2 of Table 3). Consistent with the predictions of the demand channel, these findings show that the declining trend in bond maturities is most pronounced among the bonds that are marginal matches for insurers.

D. Insurance Company Characteristics and the Decline in Bond Maturity

Next, we examine the relationship between corporate bond maturities and the market shares of different types of insurance companies. Within the insurance sector, life insurance companies tend to have longer-term liabilities and accordingly stronger preferences for longer-term assets when compared to P&C insurance companies. Therefore, if the maturity preferences of insurance companies drive the declining trend in bond maturities, this trend should be more closely associated

TABLE 9

Insurer Characteristics and the Decline in Bond Maturities

Table 9 investigates whether the decline in bond maturity varies with certain insurer characteristics. The regression model is:

$$\log(\text{BOND\_MATURITY}_i) = \alpha + W'_{jt}\beta + Z'_i\delta + X'_t\gamma + \tau\text{TREND}_t + \varphi\text{INSURER\_RELATED\_VARIABLE}_t + \varepsilon_i,$$

where BOND_MATURITY_i is the maturity of bond i; α is the intercept; W_{jt}, Z_i, and X_t represent firm-, bond-, and macro-level controls, respectively; TREND_t is the difference between the year of bond issuance and the year when our sample period starts (1975); $\text{INSURER\_RELATED\_VARIABLE}_t$ refers to LIFER_INSURER_MARKET_SHARE (in columns 1–2), PC_INSURER_MARKET_SHARE (in columns 3–4), or LIFE_INSURER_BOND_HOLDINGS (in columns 5–6); and ε_i is the error term. LIFE_INSURER_MARKET_SHARE, constructed using the U.S. flow of fund data, is the ratio of the amount of corporate bonds owned by life insurance companies to the total corporate bonds outstanding. PC_INSURER_MARKET_SHARE is defined in a similar way using the amount of corporate bonds owned by P&C insurance companies as the numerator. For the ease of comparing their coefficient estimates, PC_INSURER_MARKET_SHARE is scaled to be equal to LIFE_INSURER_MARKET_SHARE at the beginning of the analysis period. LIFE_INSURER_BOND_HOLDINGS is defined using data from the *Life Insurers Fact Book of 2017* as the percentage of bond holdings (relative to assets) of life insurance companies. Refer to Table 1 for sample selection criteria, Table 2 for the list of firm-, bond-, and macro-level control variables, and Table IA-1 of the Supplementary Material for variable definitions and data sources. Standard errors used to compute t-statistics are clustered at the firm level. ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively.

	Dependent Variable: log(BOND_MATURITY)					
Model	Life Insurance		P&C Insurance		Bond Investments of Life Insurers	
Control Variables	1	2	3	4	5	6
TREND × 100	−0.17	0.11	−0.47*	−0.14	−0.84***	−0.53*
	(−0.59)	(0.33)	(−1.86)	(−0.48)	(−4.23)	(−1.89)
LIFE_INSURER_MARKET_SHARE	1.87***	1.88***	–	–	–	–
	(4.48)	(3.74)	–	–	–	–
PC_INSURER_MARKET_SHARE	–	–	1.13***	1.31***	–	–
	–	–	(3.89)	(3.83)	–	–
LIFE_INSURER_BOND_HOLDINGS	–	–	–	–	1.09***	1.44***
	–	–	–	–	(4.70)	(5.43)
No. of obs.	19,101	19,101	19,101	19,101	19,101	19,101
Adj. R^2 (%)	22.33	17.41	22.39	17.54	22.42	17.63
Chi-square test for the difference in TREND coefficients						
	(1) versus (3)		(2) versus (4)		(5) versus (1) of Table 3	(6) versus (2) of Table 3
	2.99*		1.37		20.87***	24.01***
Firm fixed effects	No	Yes	No	Yes	No	Yes
Industry fixed effects	Yes	No	Yes	No	Yes	No
Firm IPO decade fixed effects	Yes	No	Yes	No	Yes	No
Firm-level controls	Yes	Yes	Yes	Yes	Yes	Yes
Bond-level controls	Yes	Yes	Yes	Yes	Yes	Yes
Macro-level controls	Yes	Yes	Yes	Yes	Yes	Yes

with the market share of life insurance companies than that of P&C insurance companies.

To test this prediction, we construct quarterly ownership shares for life and P&C insurance companies in the corporate bond market using the U.S. flow of funds data and then estimate their influence on bond maturities. Columns 1–2 and 3–4 of Table 9 report the results from the regressions of bond maturity that control for market shares of life and P&C insurance companies, respectively, as additional control variables. The coefficient estimates on LIFE_INSURER_MARKET_SHARE and PC_INSURER_MARKET_SHARE variables are positive and significant in both OLS and fixed effects specifications. Hence, market shares of both insurance company types are positively associated with bond maturity. When controlling for LIFE_INSURER_MARKET_SHARE, the coefficient on TREND is insignificant in both OLS and fixed effects models. On the other hand, the coefficient on TREND is −0.47 and significant when controlling for PC_INSURER_MARKET_SHARE in the OLS model, and it is negative but insignificant in the fixed effects model. Table 9 shows that the coefficient on TREND estimated controlling for PC_INSURER_MARKET_SHARE is significantly more negative than that estimated controlling for LIFE_INSURER_MARKET_SHARE in the OLS model. This difference in TREND coefficients is insignificant in the fixed effects model. These findings provide suggestive evidence that the declining trend in bond maturities is more closely related to the market share of life insurance companies than that of P&C insurance companies.

We also examine the variation in our baseline results based on the aggregate asset distribution of life insurance companies over time. Life insurance companies divide their assets between a general account that supports guaranteed contractual obligations such as life insurance policies and a separate account that supports pass-through obligations such as variable annuities. As life insurance products have shifted from traditional life insurance policies to variable annuities, particularly since the 1990s (e.g., Ellul, Jotikasthira, Kartasheva, Lundblad, and Wagner (2020)), separate account assets have been rising and the fraction of life insurance company assets invested in bonds has been declining. Accordingly, if the decline in bond maturities is associated with the maturity preferences of insurance companies, then this decline in the weight of bonds in life insurance companies' assets should contribute to the aggregate decline in bond maturities.

To test the above prediction, we run our baseline regression of bond maturity using the percentage of bond investments in life insurance companies' assets (LIFE_INSURER_BOND_HOLDINGS) as an additional control variable. We construct LIFE_INSURER_BOND_HOLDINGS using the data from Table 2.11 of the 2017 ACLI report and linearly interpolate it when it is missing in a year (https://www.acli.com/posting/rp17-009). Columns 5 and 6 of Table 9 show that the coefficient estimate on LIFE_ INSURER_BOND_HOLDINGS is positive and significant in both OLS and fixed effects models, suggesting that life insurers' bond holdings are positively associated with bond maturities. These columns also show that the coefficient estimate on TREND is negative, but its economic significance declines substantially with the inclusion of LIFE_INSURER_BOND_HOLDINGS as an additional regressor. Thus, bond investments of life insurance companies appear to play an important role in determining corporate bond maturities.

Overall, this section shows that our finding that insurer market share influences bond maturity varies predictably across bond and insurance company characteristics that are associated with insurance company preferences for maturity.

E. Benefits of Matching with Insurers

In this section, we investigate how bond issuers benefit from matching with insurance companies. While acknowledging that we only observe the equilibrium outcomes and the counterfactuals are unobservable (i.e., what would happen had a firm matched with different investors), we take two approaches to answer this question.

1. Matching with Insurance Companies and the Cost of Borrowing

First, we examine the influence of matching with insurers on the issuers' costs of borrowing. This is a difficult empirical task because we do not know which bonds are a "good" or a "bad" match with insurers. For instance, a 20% insurer ownership may be high for noninvestment-grade bonds but low for investment-grade bonds due to insurance companies' preferences for safe assets. To address this issue, we construct a matching score using the predicted insurer ownership as a benchmark.

Following the same approach as in columns 1–4 of Table 7, we first predict the insurer ownership in a bond using the firm-, bond-, and macro-level variables except for bond maturity (see Section IV.B for details). We then take the difference between the actual and predicted insurer ownership and use this difference to describe the quality of the match between issuers and insurance companies. We classify a bond with a matching score less than the 25th sample percentile as having a "bad" match with insurers. LOW_INSURER_OWNERSHIP is a dummy variable that equals 1 if a bond's matching score with insurance companies is below the 25th sample percentile and 0 otherwise.

We expect the issuers of bonds with abnormally low insurer ownership to offer higher yields to issue longer-maturity bonds because insurers (the clientele that prefers longer-maturity bonds) are underrepresented in their ownership base. To test whether this is the case, we run regressions of offering yields and yield spreads on the interaction term between log(BOND_MATURITY) and LOW_INSURER_OWNERSHIP. We obtain bonds' offering yields from the Mergent FISD and SDC New Issues databases and compute yield spread as the difference between offering yield and the maturity-matched (via linear interpolation) Treasury bond yields from Bloomberg.

Columns 1–2 of Table 10 report the results from regressions of offering yields. We find that the coefficient estimate on log(BOND_MATURITY) is positive and significant and the coefficient estimate on LOW_INSURER_OWNERSHIP is insignificant, suggesting that longer maturity is positively associated with higher yields (consistent with an upward-sloping yield curve) and abnormally low insurer ownership does not directly affect yields when averaged across all issues.

However, we find that the interaction term between log(BOND_MATURITY) and LOW_INSURER_OWNERSHIP is positive and significant, suggesting that abnormally low insurer ownership does influence yields through its interaction with maturity. For instance, the magnitudes of the coefficients in column 1 of Table 10 suggest that doubling the maturity results in an 80 basis points ($0.80 = (0.91 + 0.25) \times \ln(2)$) increase in offering yields if insurer ownership is abnormally low, and a 63 basis points ($0.63 = 0.91 \times \ln(2)$) increase otherwise. Thus, these estimates suggest that bonds that are poorly matched with insurance companies can double their maturity at 27% ($0.27 = 80/63–1$) higher incremental cost than issues that are well-matched with insurance companies. We find qualitatively similar results using yield spread as the dependent variable in columns 3 and 4 of Table 10.

2. Matching with Insurance Companies and the Ability to Issue Long-Term Bonds

Our second test examines the potential benefit of matching with noninsurers that arise from a salient firm characteristic: the firm's informational asymmetry.

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TABLE 10

Abnormally Low Insurer Ownership and Firms' Borrowing Costs

Table 10 investigates the influence of low insurer ownership on the cost of issuing long-term corporate bonds. The regression model is:

$$\text{ISSUANCE\_COST}_i = \alpha + \alpha_t + W'_{jt}\beta + Z'_i\delta + X'_t\gamma + \varphi\log(\text{BOND\_MATURITY}_i) + \zeta\text{LOW\_INSURER\_OWNERSHIP}_i + \upsilon\log(\text{BOND\_MATURITY}_i) \times \text{LOW\_INSURER\_OWNERSHIP}_i + \varepsilon_i,$$

where ISSUANCE_COST$_i$ is the offering yield or yield spread of bond i; α is the intercept; α_t is year fixed effects; W_{jt}, Z_i, and X_t represent firm-, bond-, and macro-level controls, respectively; log(BOND_MATURITY$_i$) is the natural logarithm of bond i's maturity in years; LOW_INSURER_OWNERSHIP$_i$ is a dummy variable indicating bond i with lower than the expected insurer ownership; and ε_i is the error term. To define LOW_INSURER_OWNERSHIP dummy, we first predict insurer ownership in a bond as in Table 7 and create an abnormal insurer ownership variable as the difference between the actual and predicted insurer ownership. LOW_INSURER_OWNERSHIP dummy equals 1 for the bonds ranked within the lowest 25th percentile of abnormal bond ownership in our sample and 0 otherwise. The dependent variable in columns 1–2 and 3–4 is OFFERING_YIELD and YIELD_SPREAD, respectively. OFFERING_YIELD is a bond's yield to maturity at its issuance. YIELD_SPREAD is the difference between a bond's offering yield and the maturity-matched Treasury rate. We linearly interpolate the Treasury rates when a perfect maturity match is unavailable. Refer to Table 1 for sample selection criteria, Table 2 for the list of firm-, bond-, and macro-level control variables, and Table IA-1 of the Supplementary Material for variable definitions and data sources. Standard errors used to compute t-statistics are clustered at the firm level. ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively.

	Dependent Variable			
	OFFERING_YIELD		YIELD_SPREAD	
Control Variables	1	2	3	4
log(BOND_MATURITY)	0.91***	1.01***	0.04	0.13***
	(21.60)	(26.87)	(1.07)	(4.67)
LOW_INSURER_OWNERSHIP	−0.14	−0.12	−0.06	−0.07
	(−0.94)	(−0.92)	(−0.43)	(−0.57)
log(BOND_MATURITY) × LOW_INSURER_OWNERSHIP	0.25***	0.14**	0.24***	0.13**
	(4.05)	(2.08)	(3.95)	(2.24)
No. of obs.	5,734	5,734	5,734	5,734
Adj. R^2 (%)	73.02	62.86	68.67	55.43
Firm fixed effects	No	Yes	No	Yes
Industry fixed effects	Yes	No	Yes	No
Firm IPO decade fixed effects	Yes	No	Yes	No
Year fixed effects	Yes	Yes	Yes	Yes
Firm-level controls	Yes	Yes	Yes	Yes
Bond-level controls	Yes	Yes	Yes	Yes
Macro-level controls	Yes	Yes	Yes	Yes

Firms that have substantial information asymmetries may find long-maturity bonds relatively undesirable because they may not want to lock in unfavorable rates for a long period of time (e.g., Barclay and Smith (1995), Berger, Espinosa-Vega, Frame, and Miller (2005), and Custódio et al. (2013)). These firms may be forced to issue longer maturity bonds when insurer market share is high (because insurers are relatively willing purchasers of long-maturity issues) and able to switch to shorter-term bonds when other investors who demand shorter maturity enter the corporate bond market. For instance, Lugo (2021) shows that an increase in the market share of money market mutual funds is associated with an increase in the use of short-term debt by corporations.

To test whether this is the case, we compare the maturity trends within subsamples of high and low information asymmetry firms. We use the Datastream database to define high and low information asymmetry subsamples based on sample medians of NUMBER_OF_ANALYSTS_FOLLOWING and ANALYST_FORECAST_DISPERSION. NUMBER_OF_ANALYSTS_FOLLOWING is the number of analysts covering a firm and ANALYST_FORECAST_DISPERSION is the standard deviation of analyst forecasts. Table 11 reports the results from the

TABLE 11

Variation in the Maturity Trend by Firms' Information Asymmetry

Table 11 investigates how the declining bond maturity trend varies with firms' information asymmetries. The regression model is:

$$\log(\text{BOND\_MATURITY}_i) = \alpha + W'_{jt}\beta + Z'_i\delta + X'_t\gamma + \tau\text{TREND}_t + \varepsilon_i,$$

where BOND_MATURITY$_i$ is the maturity of bond i; α is the intercept; W_{jt}, Z_i, and X_t represent firm-, bond-, and macro-level controls, respectively; TREND$_t$ is the difference between the year of bond issuance and the year when our sample period starts (1975); and ε_i is the error term. Columns 1–2 and 3–4 report the regression results using subsamples of bonds issued by firms with low and high numbers of analysts following, respectively. Columns 5–6 and 7–8 report the regression results using subsamples of bonds issued by firms with high and low analyst forecast dispersion, respectively. Analyst forecast dispersion is defined as the standard deviation of analyst forecasts. High and low subsamples are classified based on the sample medians. Refer to Table 1 for sample selection criteria, Table 2 for the list of firm-, bond-, and macro-level control variables, and Table IA-1 of the Supplementary Material for variable definitions and data sources. Standard errors used to compute t-statistics are clustered at the firm level. ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively.

	Dependent Variable: log(BOND_MATURITY)							
Model	Low Number of Analysts Following		High Number of Analysts Following		High Analyst Forecast Dispersion		Low Analyst Forecast Dispersion	
Control Variables	1	2	3	4	5	6	7	8
TREND × 100	−1.71***	−1.21***	−0.35	−0.33	−1.37***	−1.53***	−0.64*	0.05
	(−9.05)	(−4.48)	(−0.96)	(−0.64)	(−5.74)	(−4.22)	(−1.85)	(0.13)
No. of obs.	9,351	9,351	9,750	9,750	9,872	9,872	9,229	9,229
Adj. R^2 (%)	29.57	19.66	20.13	17.17	22.87	16.30	23.14	18.71
Chi-square test for the difference in TREND coefficients								
	(1) versus (3)		(2) versus (4)		(5) versus (7)		(6) versus (8)	
	11.75***		2.35		3.47*		9.56***	
Firm fixed effects	No	Yes	No	Yes	No	Yes	No	Yes
Industry fixed effects	Yes	No	Yes	No	Yes	No	Yes	No
Firm IPO decade fixed effects	Yes	No	Yes	No	Yes	No	Yes	No
Firm-level controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bond-level controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Macro-level controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

baseline bond maturity regressions (columns 1 and 2 of Table 3) for subsamples of high and low information asymmetry issuers defined using NUMBER_OF_ANALYSTS_FOLLOWING (columns 1–4) and ANALYST_FORECAST_DISPERSION (columns 5–8).

Table 11 reports that the coefficient estimate on TREND is negative and significant for issuers that have low analyst coverage (columns 1 and 2) and high analyst disagreement (columns 5 and 6). These are the high-information asymmetry issuers. On the other hand, the remaining columns in Table 11 show that the TREND coefficient is generally insignificant for the low information asymmetry issuers. These findings are consistent with high information asymmetry firms issuing longer-term bonds when insurer market share is high and switching to shorter maturity bonds as other investors that demand shorter maturity bonds enter the corporate bond market.

The findings in this section show that the maturity decline is more pronounced among high information asymmetry firms relative to the maturity decline among low information asymmetry firms. These findings suggest that the decrease (increase) in insurer market share may benefit those firms that are willing to issue shorter (longer) maturity bonds.

V. Microfoundations: Association of Insurance Company Ownership With Bond Maturity

In Section III.A, we find that, controlling for firm-, bond-, and macro-level variables, insurance company ownership is positively associated with bond maturity. However, this partial correlation between insurer ownership and bond maturity does not necessarily indicate that a decline in insurer ownership may cause a decline in bond maturities. In this section, we study the variation in the maturity of new bonds issued following natural disasters to investigate the direction of causality between insurance company ownership and bond maturity.

Massa and Zhang (2021) show that insurance companies affected by Hurricane Katrina liquidated their corporate bond holdings and that the fire-sale effects of this demand shock lasted for several months. We extend their findings and utilize the 10 natural disasters that led to the largest insured losses during our sample period as an exogenous shock to insurance company ownership and investigate whether the maturities of new bonds issued during the disaster quarters have shorter maturities.[6] As most insurance companies offer both life insurance and P&C insurance products, we expect natural disasters to reduce the average insurance company ownership in bonds.

In order for the average maturity of new bond issues to decline immediately after natural disasters, issuers should be able to change the maturity of their bond issues quickly in response to changes in market conditions. To issue bonds, firms first file a registration statement with the SEC. This registration statement generally mentions the amount of offering, its seniority, the purpose of the offering, and issuer characteristics. Firms later issue a pricing document (a supplemental prospectus or a final term sheet) that discloses the details of the bond issue, including its price and maturity. We randomly picked 100 bonds from our sample and found that, on average, the pricing document is released 7.5 days before the offering date with a median of 6 days. Therefore, the public companies in our sample appear to be able to change the terms of their bond offerings quickly in response to natural disasters.

To implement this natural disaster test, we define a DISASTER_DUMMY variable that equals 1 for 627 bonds issued during the calendar quarter in which a large natural disaster occurred and 0 otherwise. Columns 1 and 2 of Table 12 report the results from OLS and firm fixed effects regressions of INSURER_OWNERSHIP, respectively. The coefficient estimate on DISASTER_DUMMY is −2.70 in the OLS model and − 2.07 in the firm fixed effects model, indicating a more than 2 percentage point decline in insurance company ownership in bonds following natural disasters (measured at the end of the natural disaster quarter). Hence, natural disasters appear to serve as a negative shock to insurance companies' demand for bonds.

Next, we test whether bonds that have low insurance company ownership due to natural disasters also have shorter maturities. Column 3 of Table 12 reports

[6]We identify the 10 largest natural disasters based on the insured losses provided by Swiss Re and the Insurance Information Institute. The disasters with their event quarter and insured losses (in billions) are: Charley (2004Q3; $10), Frances (2004Q3; $6), Ivan (2004Q3; $16), Katrina (2005Q3; $81), Rita (2005Q3; $13), Wilma (2005Q4; $15), Ike (2008Q3; $23), the Super Outbreak (2011Q2; $8), Irene (2011Q3; $6), and Sandy (2012Q4; $30).

TABLE 12

Microfoundations: Using Natural Disasters to Examine the Effects of Insurer Ownership on Bond Maturity

Table 12 presents the results from the regressions that investigate the influence of large natural disasters (exogenous shocks to the demand for bonds from insurance companies) on INSURER_OWNERSHIP (in percentage terms) and log(BOND_MATURITY). We identify the 10 largest natural disasters between 1999 and 2015 based on their insured losses: Charley (2004Q3), Frances (2004Q3), Ivan (2004Q3), Katrina (2005Q3), Rita (2005Q3), Wilma (2005Q4), Ike (2008Q3), the Super Outbreak (2011Q2), Irene (2011Q3), and Sandy (2012Q4). The regression model is as follows:

$$\text{DEPENDENT\_VARIABLE}_i = \alpha + \alpha_t + W'_{jt}\beta + Z'_i\delta + X'_t\gamma + \upsilon\text{DISASTER\_DUMMY}_i + \varepsilon_i,$$

where α is the intercept; α_t is year fixed effects; W_{jt}, Z_i, and X_t represent firm-, bond-, and macro-level control variables, respectively; DISASTER_DUMMY$_i$ equals 1 for 627 bonds issued during the disaster quarters and 0 for the remaining; and ε_i is the error term. The dependent variables in columns 1–2 and 3–4 are INSURER_OWNERSHIP and log(BOND_MATURITY), respectively. Refer to Table 1 for sample selection criteria, Table 2 for the list of firm-, bond-, and macro-level control variables, and Table IA-1 of the Supplementary Material for variable definitions and data sources. Standard errors used to compute *t*-statistics in parentheses are clustered at the firm level. ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively.

	Dependent Variable			
	INSURER_OWNERSHIP		log(BOND_MATURITY)	
Control Variables	1	2	3	4
DISASTER_DUMMY	−2.70***	−2.07***	−0.07***	−0.05**
	(−3.45)	(−2.79)	(−2.75)	(−2.17)
No. of obs.	7,337	7,337	7,337	7,337
Adj. R^2 (%)	42.13	24.04	29.59	24.08
Firm fixed effects	No	Yes	No	Yes
Industry fixed effects	Yes	No	Yes	No
Firm IPO decade fixed effects	Yes	No	Yes	No
Year fixed effects	Yes	Yes	Yes	Yes
Firm-level controls	Yes	Yes	Yes	Yes
Bond-level controls	Yes	Yes	Yes	Yes
Macro-level controls	Yes	Yes	Yes	Yes

the estimates from the OLS regression of log(BOND_MATURITY) and shows that the coefficient on DISASTER_DUMMY is −0.07 and significant, indicating an average of 7% decline in maturities of bonds issued during the natural disaster periods. Column 4 shows that the results are similar when controlling for firm fixed effects. These findings suggest that a 10 percentage point decline in insurance company ownership would result in a 24% decline in bond maturity. Therefore, it is plausible that the decline in the insurance company ownership share in the corporate bond market from 40% in the 1970s to 25% in the 2000s caused the 50% decline in bond maturities observed during the same period.

Overall, our findings in this section suggest that changes in insurance company ownership in bonds can have a causal effect on their maturities. These findings validate the underlying mechanism for our hypothesis that a decline in insurance companies' demand for bonds can lead to shorter bond maturities.

VI. Testing Alternative Hypotheses

A. Changes in Firm or Bond Characteristics Do Not Explain the Maturity Trend

We document in Section III.A that insurance companies invest more in safer bonds. As riskier firms also have shorter bond maturities, an increase in the riskiness of bond issuers through time may result in both shorter bond maturities and lower insurer market share. Even if issuers do not become riskier, Baghai et al. (2014) show that credit rating agencies have become more conservative over time. If this leads to fewer investment-grade bonds, independent of the riskiness of issuers, the market share of insurers and the maturity of new bond issues may decline.

In our baseline regressions, we control for bond and issuer characteristics to address this concern. In this section, we introduce the time-series averages of bond and firm characteristics reported in Figures IA-1 and IA-2 of the Supplementary Material as additional regressors in our maturity regressions to test whether the trends of firm and bond characteristics can explain the decline in bond maturities.

Columns 1–14 in Table IA-2 of the Supplementary Material report the coefficient estimate on TREND from the OLS regressions, but the firm fixed effects regressions produce broadly similar results. We find that the coefficient estimate on TREND is negative and significant in all specifications. Therefore, consistent with the findings of Custódio et al. (2013), the trends in the average characteristics of bonds or issuers during our analysis period are unlikely to explain the maturity decline.

B. Other Trending Variables Do Not Explain the Maturity Trend

In this section, we investigate whether trending variables other than the issuer or bond characteristics included in the baseline regressions can explain the decline in bond maturities. The trending variables that we consider in this section are the corporate bond ownership shares for pension funds, foreign investors, households and nonprofit organizations, and U.S.-chartered depository institutions. We also consider firms' cash holdings, volatility of interest rates, and inflation as additional controls. We report the regression results in Table IA-3 of the Supplementary Material. For brevity, we only report the results from the OLS regressions, but the firm fixed effects regressions produce broadly similar results.

Pension funds also prefer investing in long-term bonds and, similarly to insurance companies, their share in the U.S. corporate bond market declined from 30% to 11% between 1975 and 2015. To test whether the declining presence of pension funds can explain the maturity trend, we compute PENSION_MARKET_SHARE using the U.S. flow of funds data as the amount of pension fund ownership (FL573063005 + FL343063005 + FL223063045) in U.S. corporate bonds and foreign entity bonds (issued through U.S. dealers and purchased by U.S. residents) divided by their total outstanding amount (FL893163005). Column 1 of Table IA-3 shows that PENSION_MARKET_SHARE is a positive and significant determinant of bond maturity, but column 2 shows that the coefficient estimate on TREND remains negative and significant controlling for PENSION_MARKET_SHARE. Hence, the decline in the share of pension fund ownership in the corporate bond market cannot explain the declining trend in bond maturities.

Another noticeable trend is that the share of foreign investor ownership increased from 4.5% to 26.4% during our analysis period. Using the U.S. flow of fund data, we calculate the FOREIGNER_MARKET_SHARE as the amount of foreign investors' ownership (LM653063005) in U.S. corporate bonds and foreign entity bonds (issued through U.S. dealers and purchased by U.S. residents) divided by their total outstanding amount (FL893163005). Column 3 of Table IA-3 shows that FOREIGNER_MARKET_SHARE is significantly negatively associated with bond maturity and column 4 shows that the TREND coefficient is still negative and significant controlling for it, suggesting that the variation in the market share of foreign investors does not explain the decline in bond maturities.

The ownership share for households and nonprofit organizations and U.S.-chartered depository institutions did not evolve noticeably during our analysis period. Unsurprisingly, in untabulated tests, we find that controlling for their bond ownership shares in our baseline maturity regression cannot explain the decline in bond maturities.

During our analysis period, firms in the U.S. have also increased their cash holdings (e.g., Foley, Hartzell, Titman, and Twite (2007), Bates, Kahle, and Stulz (2009), and Harford et al. (2014)). This may affect firms' debt maturity as higher levels of cash reduce the cost of failing to roll over debt. Accordingly, higher levels of cash holdings may incentivize firms to issue shorter-term debt to reduce their cost of borrowing. Our baseline regression of bond maturity controls for the effect of cash holdings indirectly by including TANGIBILITY as a regressor. Alternatively, column 5 of Table IA-3 directly accounts for the influence of firm cash holdings using the ratio of cash and equivalents to total assets as an additional control variable in the regression. The coefficient estimate on CASH_TO_ASSETS variable is negative, consistent with higher cash holdings being associated with shorter debt maturity. However, the coefficient on TREND is negative and significant after controlling for CASH_TO_ASSETS, indicating that variation in firms' cash holdings cannot explain the decline in bond maturity.

We then investigate whether changes in interest rate volatility can explain the maturity decline. Given that longer-maturity bonds have a higher duration (i.e., higher interest rate risk), the demand for long-term bonds may be lower when interest rate volatility is higher. Accordingly, firms may issue shorter-maturity bonds as interest rate volatility increases, or longer-maturity bonds as interest rate volatility decreases. To test this prediction, we construct INTEREST_VOLATILITY as the standard deviation of the daily interest rate on the 10-year Treasury bond in the quarter right before bond issuance. Column 6 of Table IA-3 includes INTEREST_VOLATILITY as an additional control variable in the regressions of bond maturity and shows that the coefficient on TREND maintains its negative sign and significance. Hence, changes in the volatility of interest rates cannot explain the decline in bond maturities.

Finally, we investigate whether controlling for inflation can explain the maturity decline as it may influence investors' preferences for holding long-term bonds. In column 7 of Table IA-3, we explicitly control for inflation by including the CPI as an additional regressor. The coefficient estimate on TREND maintains its negative sign and significance. We conclude that variations in inflation do not explain the decline in bond maturities.

Our results in this section show that controlling for firms' cash holdings, interest rate volatility, inflation, and the bond market shares for major investors other than insurance companies and mutual funds cannot explain the decline in bond maturities. We report in Table IA-4 of the Supplementary Material that our main findings are also robust to a variety of additional tests.

VII. Conclusion

The average maturity of new corporate bond issues in the U.S. has declined from 20 years in the 1970s to its current level of 10 years, and the known determinants of debt maturity can only partially explain this decline. In this article, we find that controlling for the ownership share of insurance companies – who prefer investing in longer maturity bonds – in the corporate bond market explains a significant part of the unexplained maturity decline. We run several additional tests to understand the mechanism driving this relationship and find evidence that, as the market share of insurance companies declines, insurer demand for certain types of bonds also declines and thus the issuers of these bonds lower the maturity of their new bond issues to attract other investors that demand shorter maturity bonds, reducing the average maturity of new bond issues. We also investigate how firms benefit from matching with insurance company investors and find that matching with insurance companies lowers the cost of issuing long-term debt and allows firms to issue longer maturity bonds.

Overall, our article shows that the decline in corporate bond maturities over the last 40 years was due in part to the decline in the share of insurance company ownership in the U.S. corporate bond market. This finding illustrates how the maturity preferences of institutional investors can influence the maturity of securities offered and the time-series variation in corporate debt maturities. Our article also contributes to the literature by showing how insurance companies match with firms and the benefits of this matching.

Supplementary Material

To view supplementary material for this article, please visit http://doi.org/10.1017/S0022109022000692.

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