Investor-Driven Corporate Finance: Evidence from Insurance Markets

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Abstract

I study the causal effect of investors' demand for corporate bonds on nonfinancial firms' corporate finance and investment activities, using granular data on U.S. insurance companies' bond transactions. Liquidity inflows from insurance premiums combined with insurers' persistent investment preferences identify demand shifts, which raise bond prices and reduce firms' funding costs. In response, firms issue more bonds, especially when they have well-connected bond underwriters. The proceeds are used for investment rather than shareholder payouts, particularly by financially constrained firms. My results emphasize the role of bond investors for nonfinancial firms and, thereby, suggest important policy implications.

Keywords: Institutional Investors, Insurance, Bond Issuance, Corporate Investment.

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1 Introduction

Availability of external finance is a first-order determinant of economic activity. An extensive literature provides evidence that relationship lending by banks affects corporate activities (Chodorow-Reich, 2014; Huber, 2018). In comparison, far less is known about the role of bond investor demand for nonfinancial firms, although bonds are a main source of firms' external finance. Addressing this void, I study the effect of bond investor demand shifts on corporate financing and investment activities, drawing on granular data on U.S. insurance companies.

The corporate bond market is dominated by institutional investors, such as insurance companies. These investors often purchase bonds in the secondary market rather than directly from firms in the primary market, which is an important difference to banks. For instance, I document that insurers purchase 62% of corporate bonds in the secondary market. Recent studies document that investors affect secondary market prices (Koijen and Yogo, 2019; Bretscher et al., 2022). Whereas bond prices correlate with economic activity in general (Gilchrist and Zakrajšek, 2012), the role of investor demand is not obvious. First, arbitrageurs dampen investors' price impact in the secondary market. Thus, it may be too weak or short-lived to meaningfully affect firms' bond issuing costs in the primary market. Second, bonds' weak information sensitivity (Dang et al., 2020) mutes managers' incentives to use prices as signals about investment opportunities, which is an important difference to stocks (Bakke and Whited, 2010; Dessaint et al., 2019).

This paper contributes to the literature by offering causal evidence that quantifies the effect of investors' bond demand on corporate financing and investment activities through investors' price impact in the secondary bond market. Identifying the effect of investor demand is challenging because it might correlate with firms' investment opportunities and, thereby, conflate demand and supply. I overcome this challenge using micro-level data on U.S. insurance companies, which are among the largest groups of corporate bond investors. To identify firm-specific nonfundamental bond demand shifts, I combine liquidity inflows from insurance premiums paid by households and segmentation of insurers across bond issuers.[1] These demand shifts associate with increases in insurers' bond purchases in the secondary

[1]Insurers collect premiums from customers to accumulate reserves for future claims. There is sizable variation in total premiums received, which stems, e.g., increased risk salience after natural disasters.

market and, thereby, raise bond prices.

There are two main findings. First, in response to premium-driven bond purchases, firms opportunistically increase their net bond issuance, especially when they have well-connected underwriters. Second, firms use the proceeds to raise investment rather than shareholder payouts. This prompts a negative stock price reaction for less financially constrained firms.

These results offer new insights into the interaction of non-bank financial intermediaries with the real economy. They emphasize that investors significantly affect corporate financing and investment activities through their price impact. My findings highlight the importance to explicitly consider investors in economic models and policy, especially in light of firms' increasing reliance on bond financing (Berg et al., 2021; Darmouni and Papoutsi, 2022), and point to significant effects of central bank asset purchases through price impact.[2]

I construct a rich data set that merges micro-level data on U.S. insurance companies and nonfinancial firms. These data include, for each insurer, customer locations and premiums paid, security-level bond transactions, bond prices, and financial information about the bonds' issuers. The final data set covers nearly 1,500 insurers and 871 nonfinancial firms.

I document two salient characteristics of insurers' investment behavior, which motivate the identification strategy. First, insurers invest a significant share of insurance premiums from households in corporate bonds, reflecting opportunity costs of stockpiling cash. This result is robust to controlling for insurer characteristics, such as their investment success, and it is consistent with premiums being insurers' main source of financing. Second, insurers segment into clienteles for bond issuers: The insurers that invested in a given firm's bonds in the past are 14 times more likely than other insurers to purchase this firm's bonds.[3] For each firm, I label this set of insurers the firm's *potential investors*. Clienteles are highly fragmented: on average, a firm's bonds are held by only 69 insurers (5% of the insurers in the sample). Exploiting this fragmentation, I construct a Bartik-style instrument for the insurance sector's bond demand based on the total household insurance premiums of a firm's potential investors. To remove variation resulting from local ties between insurers and firms, I consider only the premiums paid by customers that are located outside the state in which a firm is located.

[2]U.S. nonfinancial firms' bond debt as a share of total debt increased from below 40% in the 1980s to more than 55% in 2020 (see Appendix Figure IA.14).

[3]I provide evidence that the persistence in bond investments is partly driven by time-invariant investment preferences and by information asymmetries, which may induce due diligence costs.

Importantly, the identification strategy does not require insurance premiums to be completely random. Instead, it rests on the assumption that, conditional on firm and quarter fixed effects, a firm's investment opportunities do not correlate with its potential investors' premiums. Supporting this assumption, I document that unobserved firm-specific shocks do not explain the significantly larger bond purchases of potential investors with strong premium growth compared to other insurers. This result suggests as-good-as-random matching of insurers and firms. Several observations further support the identifying assumption, such as a non-positive correlation of the instrument with equity prices, ruling out a simultaneous increase in firms' profitability. Moreover, in robustness analyses I highlight the impact of natural disasters on life insurance demand as one source of identifying variation in premiums.

Bond prices are useful to verify the empirical strategy. I start by exploring the response of bond returns in the secondary market to demand shifts, controlling for granular bond characteristics. The point estimate implies that bond returns increase by 54 basis points (bps) when insurers' bond purchases increase by 1% of the firm's outstanding bonds; equivalently, yields decrease by 10 bps. The implied price elasticity of demand equals -1.9 and, thus, is larger than estimates for that of stocks (Koijen and Yogo, 2019), consistent with bonds' high substitutability. Bond prices do not react *before* an increase in premium-driven demand, and they revert back to initial levels after two quarters. These dynamics are consistent with the empirical strategy capturing nonfundamental demand shifts (Duffie et al., 2007).

I also find that insurers' premium-driven bond purchases significantly reduce yield spreads for *new* bond issuances in the primary market. Thus, it becomes relatively cheaper for firms to issue bonds. The estimate implies that issuance yield spreads decrease by close to 10 bps when insurers' bond purchases increase by 1% of the firm's outstanding bonds. The similarity of this magnitude to the secondary market price impact suggests that prices in the secondary market serve as benchmarks.

The main analysis investigates the effect of bond demand shifts on firms' financing and investment activities. The first set of results documents that firms opportunistically increase their net bond issuance in response to larger premium-driven bond purchases. This result is qualitatively unaffected by the inclusion of controls for firm and insurer characteristics. Premium-driven bond purchases also raise the issuance of bonds *relative* to commercial paper of the same firm at the same time, ruling out firm-specific capital demand shocks as alternative explanation.

My point estimate implies that net bond issuance increases by 6.27% when insurers' bond purchases increase by 1%, both relative to the firm's outstanding bonds. Thus, firms' bond debt is highly elastic to shifts in bond demand. Importantly, the identifying variation stems from insurers' bond purchases in the *secondary* market, i.e., where they interact with other market participants such as dealers. Instead, firms issue bonds in the *primary* market. Therefore, the result is *not* driven by direct interactions of insurers and firms, but by insurers' price impact in the secondary market and its pass-through to the primary market, e.g., because investors learn from prices (Grossman, 1976; Hellwig, 1980).

Firms' strong response naturally raises the question of how managers know about the favorable financing conditions. In fact, previous literature debates whether managers are, in general, sufficiently informed to time securities markets (Baker, 2009; Jenter et al., 2011). My findings reveal bond underwriters as an information source. I exploit persistent underwriter relationships of firms and insurers to construct a measure of how strongly connected a firm's underwriters are with its potential investors. Bond issuance is significantly more responsive to bond demand shifts when underwriters are well connected to potential investors. This effect strengthens if information about investors is more difficult to gather, which emphasizes the role of underwriters in disseminating information about investor demand to firms.

The second set of results documents that premium-driven bond purchases boost corporate investment. Indirect investments through acquisitions account for more than half of the effect, while direct investments reflected in capital expenditures significantly increase, as well. The sum of both increases by 6.11% when insurers' bond purchases increase by 1%, both relative to the firm's outstanding bonds. This magnitude is close to the estimated effect on net bond issuance, which suggests that the proceeds from opportunistic bond issuance are, on average, used for investment.

The sensitivity of corporate investment to external finance can be consistent either with underinvestment, since additional external finance relaxes financing frictions (Grossman, 1984; Holmstrom and Tirole, 1997), or with free cash flow problems, since additional external finance allows managers to pursue unprofitable investment projects (Jensen, 1986; Hart and Moore, 1995). To explore these potential channels, I first investigate the role of financial constraints, using the size-age index from Hadlock and Pierce (2010). The sensitivity of bond issuance to bond demand shifts does *not* differ across more- and less-constrained firms, and also not across other dimensions of financial conditions, such as creditworthiness or cash flow.

However, corporate investment responds more for more constrained firms, consistent with the presence of financing frictions. Second, I use equity prices to proxy for firms' profitability. Quarterly stock returns significantly negatively correlate with insurers' premium-driven bond purchases for less constrained firms, but there is no significant stock market reaction for the most constrained firms. Taken together, these results indicate that, on the one hand, increases in bond demand alleviate financing frictions for the most constrained firms but, on the other hand, amplify free cash flow problems for less constrained firms.

Understanding the role of bond investor demand is important for financial regulation, e.g., of insurers and pension funds, for assessing the consequences of firms' increasing reliance on bond financing (Berg et al., 2021; Darmouni and Papoutsi, 2022), and for central bank asset purchases. My results suggest that central banks' bond purchases in the secondary market can have significant effects on firms through price impact, in addition to well-documented announcement effects (Grosse-Rueschkamp et al., 2019; Koijen et al., 2021) and consistent with evidence from the Fed's Covid-19-related credit facilities (Boyarchenko et al., 2022).

Related literature. This paper is embedded in a broad literature on the importance of financial intermediaries in corporate financing and investment decisions.[4] By providing evidence that investors affect corporate decisions through their impact on bond prices, I connect this literature to studies on demand-driven asset pricing.[5]

Recent studies point to the importance of bond investors for nonfinancial firms.[6] Massa and Zhang (2021) provide evidence that firms restructured their debt after hurricane-Katrina-driven fire sales and Zhu (2021) documents debt restructuring in response to the primary market activity of bond funds, in both cases without an impact on corporate investment. Siani (2022) estimates a model of differentiated investors and bond supply, which highlights

[4]This literature includes topics such as agency problems between borrowers and lenders (Diamond, 1984; Rajan, 1992; Holmstrom and Tirole, 1997; Gustafson et al., 2021), security design (Grundy and Verwijmeren, 2018), debt certification (Sufi, 2009), relationship lending by banks (Khwaja and Mian, 2008; Chodorow-Reich, 2014; Huber, 2018), the role of bond arbitrageurs (Choi et al., 2010), mutual fund flows (Edmans et al., 2012; Hau and Lai, 2013; Dessaint et al., 2019; Wardlaw, 2020), benchmarking Dathan and Davydenko (2020), bond market access (Faulkender and Petersen, 2006), and capital supply uncertainty (Massa et al., 2013).

[5]This includes studies on index in-/exclusions (Shleifer, 1986; Greenwood, 2005; Pavlova and Sikorskaya, 2022), clientele effects (Modigliani and Sutch, 1966; Koijen and Yogo, 2019; Vayanos and Vila, 2021), intermediary asset pricing (He and Krishnamurthy, 2013; Adrian et al., 2014), investor sentiment (Baker and Wurgler, 2006), and behavioral biases (Odean, 1999).

[6]More generally, bond price fluctuations correlate with bond issuance (Greenwood et al., 2010; Ma, 2019) and economic activity (Philippon, 2009; Gilchrist and Zakrajšek, 2012).

the segmentation of primary and secondary bond markets. Coppola (2022) explores the role of investor *composition*, emphasizing that insurers, in contrast to mutual funds, mitigated adverse fire sale effects during the financial crisis 2008-09. I complement these studies mainly in three ways. First, I use detailed transaction-level data and propose a novel empirical strategy to identify demand shifts in the secondary bond market. This allows to focus on investors' price impact as the main transmission channel of demand shifts. Second, my sample spans the relatively tranquil time period from 2010 to 2018, and the identifying variation stems from demand increases instead of decreases (such as fire sales). Therefore, the results point to firms' opportunistic behavior rather than their ability to sustain negative funding shocks. Third, I examine changes in firms' overall bond debt rather than debt restructuring.

In studying the real effects of financial intermediation, this paper also relates to work on bank lending (Chodorow-Reich, 2014; Huber, 2018). An important difference is that banks affect corporate activities by monitoring (Diamond, 1984) and retaining control rights over firms (Rajan, 1992), whereas bond investors active in the secondary market do not directly interact with firms but affect corporate activities through their price impact.

The literature on stock mispricing investigates the role of mutual funds for nonfinancial firms (Edmans et al., 2012; Hau and Lai, 2013), which to a large extent builds on managers learning from stock prices about investment opportunities (Bakke and Whited, 2010; Dessaint et al., 2019). The substantial differences between equity and debt, e.g., in their information sensitivity (Dang et al., 2020) and as a signalling device (Leland and Pyle, 1977), suggest that it is important to separately consider the role of stock and bond investors.

Focusing on premiums as determinants of insurers' bond demand, my results also further the understanding of insurance intermediation, which is especially important for regulating insurance markets. My paper complements studies on insurers' investment behavior (Ellul et al., 2011; Becker and Ivashina, 2015; Becker et al., 2021; Girardi et al., 2021; Ge and Weisbach, 2021) and funding structure (Koijen and Yogo, 2016; Foley-Fisher et al., 2020; Chodorow-Reich et al., 2021; Kubitza et al., 2022). In emphasizing the role of bond underwriters to disseminate information about investor demand, I also add to recent studies on market microstructure (Barbon et al., 2019; Hendershott et al., 2020; Nikolova et al., 2020).

2 Institutional background and conceptual framework

2.1 Insurance market

Insurers perform two roles. On the one hand, they insure against risks, such as property loss and damage (P&C insurance) and longevity and mortality (life insurance). For this purpose, insurers collect insurance premiums from customers and use these premiums to build reserves for potential future claims. Premiums in the U.S. amounted to $1.7 trillion in 2019, corresponding to 8% of GDP.[7] Premiums are mainly from noncommercial insurance business (see Appendix Figures IA.2 and IA.3) and are insurers' main funding source, as reserves account for about 80% of insurers' liabilities (see Appendix Figure IA.16).

On the other hand, insurers invest premiums in financial assets. Total invested assets of the U.S. insurance sector (excluding cash) were $6.7 trillion in 2019 (Wong and Kaminski, 2020), which emphasizes the importance of insurers as investors. Corporate bond holdings account for 36% of financial assets (see Appendix Figure IA.16). Due to risk-based capital regulation, insurers have strong incentives to invest in high-quality assets (Becker and Ivashina, 2015; Becker et al., 2021). As a result, 90% of insurers' corporate bond holdings have an investment-grade rating (see Appendix Figure IA.17).

Insurers are regulated at the state level. Therefore, they are required to be licensed in each state in which they are active. As a consequence, the insurance market is geographically fragmented: The median insurer is active in 7 states.[8]

2.2 Corporate bond market

U.S. nonfinancial companies' corporate bond debt amounted to nearly $6 trillion in 2019, corresponding to 27% of U.S. GDP (Source: Z.1 Financial Accounts of the U.S.). The majority of corporate bonds is issued by investment grade borrowers, i.e., with a credit rating at or above BBB- (Berg et al., 2021). Institutional investors, namely insurers, and

[7]Insurers distinguish between *direct* premiums, which is the actual cash flow from insurance customers, and *net* premiums, which deduct reinsurance premiums. If not noted otherwise, with *premiums* I mean direct premiums as these are unaffected by insurers' reinsurance policy.

[8]For simplicity, by *states*, I mean the 50 U.S. states, the District of Columbia, and the 5 U.S. territories (American Samoa, Guam, Northern Mariana Islands, Puerto Rico, and U.S. Virgin Islands). Appendix Figure IA.19 depicts the distribution of the number of states in which insurers are active.

pension, mutual, and other funds, dominate the corporate bond market, as they jointly hold approximately 80% of bonds outstanding (see Appendix Figure IA.15).

The secondary bond market is an over-the-counter market. Previous literature highlights significant market frictions, such as costly search (Friewald and Nagler, 2019) and market power (O'Hara et al., 2018). To mitigate these frictions, investors maintain persistent relationships with dealers that intermediate between end-investors (Hendershott et al., 2020).

In the primary bond market, the average U.S. nonfinancial firm issues approximately two bonds per year with a joint offering amount of $1 billion. Underwriters intermediate between firms and end-investors by collecting investors' orders, supporting firms in setting prices, and allocating orders (Nikolova et al., 2020). To alleviate information frictions, firms and investors form persistent relationships with underwriters (Henderson and Tookes, 2012; Siani, 2021). Typically, investment banks serve both as underwriters in the primary and as dealers in the secondary market.

2.3 Conceptual framework

Motivated by theories of market timing (Stein, 1996; Baker et al., 2003; Bolton et al., 2013), I posit that nonfundamental investor demand can affect corporate activities under the following four conditions.

First, characteristics other than asset prices matter for investors. Consistent with this condition, I document that insurers persistently invest in the same subsets of firms, e.g., due to risk preferences.

Second, potential arbitrageurs are constrained, which implies that nonfundamental demand shifts affect asset prices. For example, in Duffie et al. (2007) demand shocks cause prices to deviate from assets' fundamental values and to recover only slowly over time due to search-and-bargaining frictions. Additionally, limited risk-bearing capacity (Gromb and Vayanos, 2002; Vayanos and Vila, 2021) and short-selling and borrowing constraints (Gromb and Vayanos, 2010) constrain arbitrage.

Third, primary market prices respond to nonfundamental demand shifts, e.g., because investors are eager to exploit arbitrage opportunities between primary and secondary markets (Nikolova and Wang, 2022) or learn from prices (Grossman, 1976; Hellwig, 1980; Glebkin and Kuong, 2022) or both.

Fourth, firms attempt to time the market. Indeed, surveys show that financing costs are an important driver of debt issuance (Graham, 2022). Additionally, I assemble anecdotal evidence from a large nonfinancial firm and bond underwriter, which emphasizes the price-sensitivity of bond issuance and the ability of firms to quickly react to market conditions. The extent to which firms use additional funding for investment depends on their financial constraints and incentives for precautionary saving (Bolton et al., 2013).

3 Data and descriptive statistics

I combine micro level data on insurance companies and their bond investments with information on firm characteristics and bond prices. Detailed definitions and documentation are provided in Appendix A. Table 1 provides summary statistics for the main variables, and Appendix Tables IA.18 and IA.19 for additional variables.

3.1 Insurer characteristics and investments

Financial data for U.S. P&C and life insurers are from their statutory filings collected by the National Association of Insurance Commissioners (NAIC) and obtained from S&P Global Market Intelligence. Schedule D of insurers' annual filings provides detailed information on end-of-year bond holdings and all acquisitions and disposals at the security level, including transaction date, par value, transaction price, and counterparty. Combining this information, I reconstruct end-of-quarter holdings from 2009q4 to 2018q4. I use par values instead of market values to remove the mechanical impact of issuer fundamentals. Changes in holdings can be due to actual transactions or other events such as bond redemptions or within-insurance group transfers. I consider a bond to be actively purchased if the par value and actual cost of the bond acquisition are positive and the reported counterparty does not indicate a transfer (e.g., stating "portfolio transfer") or adjustment (e.g., stating "record gain on bond"). 94% of reported bond acquisitions are flagged as actual purchases, which I further classify into primary and secondary market purchases (detailed in Appendix A.4). On average, insurers purchase 62% of corporate bonds in the secondary market, and this share is very stable over time (see Appendix Figure IA.18). In an average quarter from 2010 to 2018, U.S. insurers jointly purchase corporate bonds with a total par value of $84.5 billion.

From insurers' financial statements, I obtain information about their balance sheet, investment and insurance activities, and the state-level breakdown of direct premiums. I also retrieve the history of insurers' financial strength ratings provided by A.M. Best. I drop insurers with negligible corporate bond investments or negligible noncommercial insurance business, defined as those with less than $100,000 invested in corporate bonds (at par) or noncommercial insurance premiums below $50,000 or below 10% of total premiums in the median quarter from 2009q4 to 2018q4, respectively. Additionally, I exclude inactive insurers by dropping observations without positive direct premiums written. The final sample includes 1,458 insurers, with corporate bond holdings of $30 million and purchases of $1.4 million, mostly in the secondary market, at the median (see Table 1). Noncommercial insurance premiums written are $14.4 million at the median and quarterly premium growth ranges from -4% to 5.5% of total assets at the 5th and 95th percentiles.

I match insurers' bond investments to information about firms, i.e., the bonds' issuers, from Capital IQ and Compustat (as detailed in Appendix A.2). Among insurers in the final sample, a total of 67% of the par value of bonds held are matched to Capital IQ and Compustat in the median insurer-quarter (34%/96% at the 5/95th percentiles), and this matching probability is stable over time. The median quarterly bond purchase is $1.1 million at the insurer-by-firm level, with wide variation. The probability that a random insurer purchases a random firm's bonds is low: it occurs in only 0.45% of insurer-by-firm-by-quarter observations, which points to substantial fragmentation.

3.2 Firm characteristics

I obtain quarterly data from Compustat about U.S. firms' balance sheets and cash flows, from Capital IQ about their debt structure, and stock prices from CRSP. Firms enter the sample only if at least one insurer ever held bonds issued by the firm in the previous 8 quarters. Following the corporate finance literature, I exclude the finance (SIC 6000-6999), utilities (SIC 4900-4999), and public administration (SIC above 8999) sectors. I drop small firms (with median total assets below $1 million) and exclude observations when equity is below zero or exceeds total assets. To strengthen the data quality, I require the total debt in Capital IQ to match the total debt in Compustat.

A key variable is net bond issuance, i.e., bond issuance in excess of replacing maturing bonds, which I compute as the relative change in corporate bond debt outstanding. Thus, a firm's bond debt is required to be nonmissing in the current and previous quarter. For consistency, other variables are scaled by lagged bond debt, as well. To investigate firms' investment activities, I compute total investment as the sum of acquisition expenditures (i.e., indirect investment) and capital expenditures (i.e., direct investment), which are both cash flow variables. In addition, I consider total asset and tangible asset (property, plant, and equipment) growth, which reflect changes on firms' balance sheet. The sample is saturated with a wide range of control variables that have been shown to capture determinants of capital structure and investment activities, such as cash flow and market-to-book ratio.

The final baseline sample includes 871 firms and spans from 2010q2 to 2018q4. Since all firms in the sample have access to the bond market, they are relatively large, with total assets of $4.4 billion at the median, and jointly account for 64% of total assets of U.S. non-financial firms in Compustat.[9] Bond debt ranges from 29% to 100% of total debt at the 5th and 95th percentiles. The insurance sector holds 23% and purchases 1% of a firm's bond debt, on average, emphasizing the importance of insurers as investors.

3.3 Bond characteristics and prices

I merge the baseline firm-level sample with information about individual bonds using the CUSIP as identifier. Bond characteristics, offering yields, and credit ratings are from Mergent FISD, which is a comprehensive database for publicly-offered bonds.[10] I calculate the offering yield spread as the difference between the offering yield and the contemporaneous yield on the nearest-maturity treasury bond, and drop yankees, convertible, putable, and asset-backed bonds, bonds in foreign currency, and bonds with a floating coupon or enhancement.[11] Issuances are aggregated to the firm-by-quarter level using the total offering amount and the offering amount-weighted average yield spread. After merging with the baseline sample, nearly half of the firms remain in the sample. The median offering amount is $600 million,

[9]To provide context on the external validity of my analysis, in Appendix A.5, I compare the cross-sectional distribution of firm characteristics in my sample with that of all firms in Compustat. They closely resemble each other, with the main differences being that firms in my sample are larger and have higher leverage.

[10]Credit ratings are from S&P, Moody's, or Fitch. Following Becker and Ivashina (2015), I use the minimum rating if two ratings are available and the middle rating if three ratings are available.

[11]When the yield is not available, I use the offering price and coupon to impute the yield. Imputed yields are almost identical to those available, suggesting that the imputation procedure is reliable.

and the median offering yield spread is 1.6% across all firm-by-quarter observations with issuance activity.

I also retrieve information about firms' bond underwriters from Mergent FISD. Due to the absence of a common identifier, I match underwriters from FISD with the counterparties in insurers' bond transactions using a combination of fuzzy string merging and manual matching. This creates a uniquely detailed data set about the investor-underwriter-firm network, which connects 68% of insurers' corporate bond purchases to underwriters in FISD.[12] I define underwriter connectedness as the ratio of a firm's potential investors' bond purchases from the firm's underwriters to that from all underwriters, denoted as %UW (detailed in Section 6.5). It ranges from 9% to above 69% at the 5th and 95th percentiles, revealing large heterogeneity in the connectedness of underwriters.

Secondary market data is retrieved from the Trade and Reporting Compliance Engine (TRACE), which records the near universe of U.S. corporate bond transactions. The data is cleaned of primary market trades and cancellations, corrections, and reversals following Dick-Nielsen (2014) and aggregated to the bond-by-month level. Bond returns are given by the relative change in end-of-month prices and accrued interest plus coupon payments, $(\Delta \text{Price}_{t+x} + \Delta \text{Accrued Interest}_{t+x} + \text{Coupon payments}_{t+x})/(\text{Price}_{t-1} + \text{Accrued Interest}_{t-1})$. I drop bond-month pairs with a current or lagged total trade volume below \$100 thousand. After merging with the firm-level baseline sample, 2,612 bonds issued by 372 firms are left in the sample, which an average quarterly transaction volume of \$52 million.

4 Empirical strategy

This paper aims to estimate the causal effects of shifts in insurers' bond demand on nonfinancial firms' financing and investment activities. I relate firm outcomes $Y_{f,t}$ to the insurance sector's bond purchases of the firm's corporate bonds (issued by f) scaled by the firm's lagged bond debt:

$$Y_{f,t} = \alpha \, \frac{\text{Bond purchases}_{f,t}}{\text{Bond debt}_{f,t-1}} + \Gamma' \, C_{f,t} + \varepsilon_{f,t}. \tag{1}$$

[12]Counterparty names are missing for 20% of insurers' bond purchases (e.g., reported as "various") and thus cannot be matched.

Identifying α from Equation (1) is challenging for two reasons. First, bond purchases are an equilibrium outcome that conflates demand and supply. Second, omitted variables may simultaneously affect outcomes and bond purchases. For example, an increase in the firm's investment opportunities might raise both bond issuance and purchases.

I overcome these identification challenges by proposing an instrument for insurers' bond demand that relies on two institutional characteristics. First, I exploit the fact that insurance premiums are insurers' main funding source and, as a result, increases in insurance premiums raise insurers' demand for bonds. Second, I document that insurers persistently invest in the same small subsets of firms. Combining these characteristics, the sum of insurance premiums collected by those insurers that previously invested into a firm's bonds captures firm-specific variation in bond demand,

$$\bar{P}_{f,t} = \sum_i \mathbb{I}(\text{Investor}_{i,f,t-(1:8)}) \times \text{Premiums}_{i,f,t}. \tag{2}$$

$\text{Premiums}_{i,f,t}$ are the total noncommercial insurance premiums collected in quarter t by insurer i in states other than that in which firm f is located (Appendix A.1 details the variable construction). Excluding commercial premiums and those written in the firm's location alleviates the impact of shocks to the firm's economic environment on $\bar{P}_{f,t}$. $\mathbb{I}(\text{Investor}_{i,f,t-(1:8)})$ is an indicator variable for whether insurer i has ever held bonds issued by firm f in the previous eight quarters, in which case I call insurer i a *potential investor* of firm f. Variation in $\bar{P}_{f,t}$ across firms stems from fragmentation of potential investors across firms.

The main analyses focus on flow variables, such as net bond issuance and purchases. To construct an instrument for the latter, I define a firm's exposure to changes in potential investors' premiums as the quarterly growth in potential investors' premiums ($\Delta \log \bar{P}_{f,t}$) multiplied by the lagged share of the firm's bond debt held by insurers ($\%\text{Held by insurers}_{f,t-1}$),

$$\Delta\text{INVPremiums}_{f,t} = \Delta \log \bar{P}_{f,t} \times \%\text{Held by insurers}_{f,t-1}. \tag{3}$$

To ease the interpretation of coefficients, $\%\text{Held by insurers}_{f,t-1}$ is normalized by its unconditional mean. To control for selection of insurers relative to other investors, all firm-level regressions include $\%\text{Held by insurers}_{f,t-1}$ as a separate control variable. Below, I document that insurers smooth premium decreases, which is why only premium increases but not decreases significantly correlate with bond purchases. Therefore, I focus on *increases* in potential investors' premiums as an instrument for insurers' bond purchases, $\Delta\text{INVPremiums}^{>0}_{f,t} = \max\{\Delta\text{INVPremiums}_{f,t}, 0\}$.

The identifying assumption requires orthogonality between potential investors' premiums and unobserved firm characteristics that affect bond issuance or investment. The main analyses control for a rich set of observed firm characteristics. In particular, industry-by-time and region-by-time fixed effects remove the possibility of spurious results due to changes in macroeconomic conditions and sorting of insurers and firms across industries or geographies. Direct empirical support for the identifying assumption comes from analyses of the relation between insurance premiums and bond purchases (Section 4.1), of the determinants of insurers' investment universe (Section 4.2), and of unobserved characteristics using a within-firm estimator (Section 4.3). Finally, I highlight variation from natural disasters as a source of identifying variation, which I then use to construct an alternative, narrowly-defined instrument (Section 4.4).

4.1 Insurance premiums

I use noncommercial insurance premiums, i.e., those collected from households, excluding variation in firms' insurance take-up. The variation in noncommercial premiums is sizable, with an average absolute quarterly change in insurer-level premiums of 18%.[13] Determinants of insurance premiums include local socioeconomic characteristics (see Appendix F.1) and risk salience after natural disasters (see Section 4.4).

Since premiums are insurers' main funding source (see Appendix Figure IA.16), they determine insurers' size and, in turn, their corporate bond demand.[14] I formally establish this channel by regressing the growth in insurers' total financial investments and cash as well as the par value of corporate bond purchases on insurance premium growth in Table 2. All specifications include fixed effects that absorb time-invariant differences across insurers, insurer-specific seasonality at the calendar quarter level, such as differences in the typical timing of premium payments, and systematic shocks that affect all life or all P&C insurers, such as changes in their business environment. Column (1) reports a significant correlation

[13]The variation in premiums is not driven by small insurers or seasonality. Appendix Figure IA.20 depicts the cross-sectional distribution of premium variation.

[14]I illustrate the relationship between premiums and insurer size in a stylized model in Appendix B.1.

between premiums and investments. This effect is driven by premium *increases*, whereas premiums decreases are not significantly related to investments (column 2). The estimate implies that 42 cents of every dollar increase in insurance premiums passes through to an insurer's investments, while the effect of premium decreases is close to zero and statistically insignificant.

Stockpiling cash from premium inflows is costly for insurers, especially due to their long-term liabilities, incentivizing them to invest in financial assets. Columns (3) to (5) explore insurers' corporate bond purchases. I document that higher premium growth significantly correlates with larger bond purchases. The estimate in column (4) implies that insurers purchase 6 cents' worth of corporate bonds for every dollar increase in insurance premium growth. Due to the insurance sector's substantial size, the implied premium-driven aggregate bond purchases are economically significant and correspond to $841 million in the average quarter. As before, the coefficient on premium decreases is neither statistically nor economically significant. The results cannot be explained by changes in insurer characteristics, such as their investment return or profitability, which indicates that variation in insurance demand is the key driver. When solely using bond purchases in the secondary market as the dependent variable in column (5), the coefficient on premium increases only drops from 0.06 to 0.05. Thus, insurers respond to an increase in premiums by purchasing bonds almost entirely in the secondary market. Consistent with this result, additional regressions show that premium increases associate with purchases of old rather than newly-issued bonds (see Appendix Table IA.20).

The asymmetric effects of increases and decreases in premiums suggest that insurers smooth reductions in premiums, preventing their balance sheets from contracting. Such smoothing may enable insurers to ride out short-term fluctuations in asset prices, as emphasized by the asset insulator view of insurers (Chodorow-Reich et al., 2021). Supporting this view, Appendix Table IA.20 documents that insurers actively compensate for premium decreases by increasing their equity capital and reducing the share of insurance passed on to reinsurers, maintaining a similar level of insurance reserves.

4.2 Insurers' investment universe and potential investors

Corporate bond ownership is highly fragmented. A firm's bonds are held by 69 insurers on average and by 269 insurers at the 95th percentile, which corresponds to only 5% and 18% of all insurers in the sample, respectively. The resulting overlap in bond ownership is small: among all investors of a firm pair in the sample, 7% invest in both firms on average. Thus, the bonds of different firms are held by different insurers.[15]

I document that the set of firms that an insurer invests in, i.e., its investment universe, is very persistent over time. More than 90% of the firms currently held by a given insurer were held by the same insurer in previous quarters (see Appendix Table IA.12). This finding is consistent with evidence at the bond level (Bretscher et al., 2022) and for equity investors (Koijen and Yogo, 2019). Based on this insight, for each firm, I define those insurers as the firm's potential investors that ever held its bonds in the previous eight quarters, denoted by $\mathbb{I}(\text{Investor}_{i,f,t-(1:8)})$. This classification captures insurers' long-term investment preferences, as more than 70% of the variation in $\mathbb{I}(\text{Investor}_{i,f,t-(1:8)})$ is time-invariant, whereas changes in firm characteristics explain only 1% (see Appendix Table IA.13).

To explore how insurers' past investment allocation affects current bond purchases, I construct an insurer-by-firm-by-quarter-level data set that includes all possible pairs of firms and insurers that are included in the baseline sample at a given point in time. I estimate the following model:

$$1\{\text{Purchase}_{i,f,t}\} = \alpha \ \mathbb{I}(\text{Investor}_{i,f,t-(1:8)}) + u_{i,t} + v_{f,t} + \varepsilon_{i,f,t}, \tag{4}$$

where the indicator variable $1\{\text{Purchase}_{i,f,t}\}$ equals one if insurer i purchases firm f's bonds at time t and zero otherwise. Insurer-by-time fixed effects, $u_{i,t}$, absorb insurer-specific demand shocks. Firm-by-time fixed effects, $v_{f,t}$, absorb the effect of any firm characteristics that might influence insurers' purchases, such as the firm's investment opportunities or bond supply. Column (1) in Table 3 reports the result. The estimated coefficient implies that insurers are 14 times more likely to purchase a firm's bonds if they previously invested in the same firm. The coefficient is highly significant with a t-statistic of 17.88. Consistent with

[15] Appendix Figure IA.7 depicts the distribution common investors. Despite of fragmented bond ownership, bond portfolios are reasonably diversified, as an average insurer invests in 161 different issuers (see Appendix Table IA.19). Larger insurers invest in more bond issuers (see Appendix Figure IA.8). Bond holdings are also not concentrated across bond issuer industries or locations (see Appendix Figures IA.9 and IA.10).

this evidence on the extensive margin of purchases, I also find that insurers allocate a larger share of purchases to firms with a larger share in the existing portfolio (see Appendix Figure IA.11). Thus, insurers' past bond holdings are an important determinant of the allocation of bond purchases.

Why do insurers persistently invest in the same subsets of firms? I examine two potential, nonexclusive channels: information asymmetries and investment preferences.[16] The presence of information asymmetries between insurers and firms can result in due diligence costs for insurers when considering new investments, strengthening incentives to invest in familiar firms. Consistent with this channel, I find that insurers' past investments have a significantly stronger effect on current bond purchases for more opaque firms, namely younger and more volatile firms, controlling for bonds outstanding (see Appendix Table IA.14). Moreover, insurers might prefer investing in firms that operate in similar environments, e.g., because of expertise. To explore this channel, I include additional fixed effects in Equation (4) that absorb time-invariant investment preferences. For example, if the persistence of insurers' portfolio allocation is partly due to preferences over firms' industries, including insurer-by-industry fixed effects would reduce the point estimate for α. Consistent with such preferences, the point estimate drops by 12% (compared to that in Table 3) when including fixed effects based on the 2-digit SIC (Standard Industrial Classification) and by 5% when these are based on firms' location. The estimate also drops by 19% when accounting for insurers' risk tolerance, using either firm size quintiles or credit rating. Overall, preferences over firm industry, location, size, and credit rating jointly explain 45% of the original estimate for α.

4.3 Validity of the instrument

The instrumented second-stage regression in Equation (1) identifies the causal effect of insurers' bond purchases on firm outcomes if the exclusion restriction holds.

From Equation (2), it is apparent that the exclusion restriction holds if insurance premiums are random but it does not require it. Instead, it requires that there be no sorting of insurers and firms such that an unobserved variable simultaneously correlates with firm

[16]A potential additional channel is limited sophistication. However, persistence is not decreasing with the size of insurers' bond portfolio, which is a reasonable proxy for sophistication. Instead, sophisticated insurers might constrain their investment universe to benefit from opaque market prices (Sen and Sharma, 2021) or reduce coordination frictions (Bolton and Scharfstein, 1996).

outcomes and potential investors' premiums, conditional on controls and fixed effects. An example of problematic sorting would be if insurers tilted their investments toward firms facing the same economic environment as insurance customers. In this case, firms' investment opportunities might correlate with insurance demand of its potential investors' customers. The following provides evidence against the presence of such sorting.

Following the banking literature, I examine whether unobserved firm characteristics correlate at the insurer level in the specification of Equation (4). Under regularity assumptions, the difference in the point estimate for α in Equation (4) between regressions including and excluding the firm-by-time fixed effects $v_{f,t}$ reflects the amount of bias due to unobserved firm-level variables (Khwaja and Mian, 2008; Chodorow-Reich, 2014). To facilitate this comparison, column (2) in Table 3 includes only firm fixed effects, while column (1) additionally includes firm-by-time fixed effects. I find no significant difference in the estimated coefficients (the p-value for the hypothesis that the coefficients coincide exceeds 95%).

Columns (3) to (5) add the intensive margin of bond purchases and its relation with insurance premiums. Specifically, I regress the volume of insurers' bond purchases on $\mathbb{I}(\text{Investor}_{i,f,t-(1:8)})$, insurance premiums increases, and their interaction. The coefficient on $\mathbb{I}(\text{Investor}_{i,f,t-(1:8)})$ remains significant positive and implies that potential investors' bond purchases on average exceed those of other insurers by \$10 for each \$1 million of total assets.[17] This corresponds to 2.6 times the average bond purchase volume of insurers that are not potential investors. The coefficient on the interaction term with premium increases is also significant positive. Thus, an increase in insurance premiums amplifies the difference between potential investors and other insurers.

If unobserved characteristics were correlated with insurers being potential investors or their premiums, then the point estimates would change to reflect the omitted variables when including granular fixed effects. Instead, I find almost identical coefficients when including insurer-by-time fixed effects in column (4) or firm-by-time fixed effects in column (5) (the p-value for the hypothesis that the coefficients on the interaction term coincide exceeds 75%). These findings provide validation of as-good-as-random matching of firms and insurers.

Additionally, I directly test whether insurers tilt their investments toward economically

[17]Since insurers invest in many firms, firm-by-insurer-level bond purchases are small relative to insurers' total assets. To improve the readability of coefficients, I scale bond purchases by total assets/\$1 million and increases in insurance premiums by total assets/\$1 thousand.

connected firms by regressing $\mathbb{I}(\text{Investor}_{i,f,t-(1:8)})$ on indicators for a common economic environment in Appendix Table IA.15. The results show that insurers are not more likely to invest in firms located in the same state or region as insurance customers.[18] I also explore the social connectedness between insurance customers' and firms' locations, which captures common cultural factors and trade flows (Bailey et al., 2018), and employment per capita in the firm's industry in insurance customers' locations, which captures common industry exposures. The correlation between these variables and $\mathbb{I}(\text{Investor}_{i,f,t-(1:8)})$ is statistically and economically insignificant. Instead, I find that insurers' preferences over duration and credit risk significantly affect their investment universe: life insurers are more likely to invest in firms with better credit rating and longer-term bonds, matching the long duration of life insurance contracts, and larger insurers are more likely to invest in larger firms, consistent with minimizing transaction costs (see Appendix Table IA.16). Thus, investment allocations are driven by insurers' risk preferences and hedging needs rather than economic connections with firms. This behavior is consistent with diversification and with insurers' strong reliance on unaffiliated asset managers (Carelus, 2018).

Finally, I investigate the presence of a flow-to-performance relationship. In this case, insurance premiums might correlate with firm characteristics through insurers' (expected) investment return. However, I find that insurance premiums do *not* significantly correlate with insurers' investment yield (see Appendix F.2). Consistent with this finding, my main results are robust to controlling for insurers' investment yield and to using natural disasters as shocks to life insurance premiums (described in the next section), which mitigates potentially confounding variation in firm characteristics affecting insurance premiums. A weak flow-to-performance relationship is plausible since insurance market outcomes are driven primarily by households' desire to insure against adverse shocks.[19] According to anecdotal evidence from insurance agents, most insurance customers are not even aware of the fact that insurers invest their premiums in financial markets.

[18] I define a given insurer's customer location as the state in which the largest premiums were written in the previous eight quarters. Addressing the concern that more granular, within-state geographic proximity correlates with insurers' investments, the instrument excludes insurance premiums written in the firm's location.

[19] Furthermore, book value accounting and tight price regulation in insurance markets suggest that it is unlikely that moderate changes in bond issuer fundamentals have an immediate impact on insurance prices.

4.4 Alternative instrument based on natural disasters

Despite the supporting evidence and the rich set of controls in my analyses, unobserved firm-specific shocks cannot be controlled for in Equation (1) by definition. To provide further evidence, in the following, I narrow in on natural disasters as shocks to life insurance demand, using state-level variation in the number of fatalities caused by heat and storms.[20] Natural disasters amplify the salience of underlying risks, boosting insurance demand (Gallagher, 2014; Hu, 2021), consistent with salience theory (Bordalo et al., 2012). At the same time, I find that heat and storm events have no significant effects on life insurance payouts, which is intuitive since the number of fatalities is typically small relative to life insurers' size.[21] This is an important difference to P&C insurers, which I exclude when focusing on natural disasters. In an average year between 2009 and 2018, storms were associated with a total of 162 fatalities and heat with 105 fatalities in the U.S.

I denote by Disaster fatalities$_{i,t-1}$ life insurer i's exposure to disaster fatalities in quarter $t-1$, defined as the sum across all states s in which insurer i is active of fatalities per 100,000 residents in s at $t-1$ multiplied by the average share of premiums written by insurer i in s. Disaster fatalities$_{i,t-1}$ significantly raise life insurers' premium inflow but not customer payouts (see Appendix Table IA.17), resulting in higher bond purchases (see Table 2). I aggregate the exposure to disaster fatalities across a firm's potential investors, and substitute the resulting variable for premiums $\overline{P}_{f,t}$ in Equation (3), which yields the alternative instrument $\Delta\text{INVDisasters}^{>0}_{f,t}$. Appendix B.3 details the instrument construction.

$\Delta\text{INVDisasters}^{>0}_{f,t}$ identifies bond demand shifts if insurers do not sort into firms that are exposed to the same disasters. To ensure that firms are not directly affected by the same disasters as insurers, I exclude, for each firm, disasters in the state in which the firm is located and all of its neighboring states. Including firm region-by-time fixed effects in regressions absorbs more widespread spatial impact of disasters. Moreover, I include firm-by-calendar quarter fixed effects to remove spurious correlation resulting from seasonality of disasters. Conditional on these fixed effects, the identifying variation stems from differences in potential investors' disaster exposure, holding firms' disaster exposure constant. Since

[20] Heat and storms are more frequent and widespread than other hazards. They jointly affect almost all U.S. states, providing wide variation (see Appendix Figures IA.12 and IA.13).

[21] Even hurricane Katrina, the costliest disaster in the U.S. to the present day, had only a moderate effect on life insurers' expenses (Towers Watson, 2013).

disasters presumably occur independently of firm characteristics, using $\Delta\text{INVDisasters}^{>0}_{f,t}$ as an alternative instrument for insurers' bond purchases strengthens the identification, while illustrating one source of plausibly exogenous variation in insurance premiums.

5 Bond prices and bond demand

Before presenting the firm-level results, in this section I investigate the price impact of insurers' bond demand. This analysis is useful because it validates the identification strategy and reveals the transmission of investor demand shifts through prices.

5.1 Secondary market

The secondary bond market is a natural starting point for the analysis since insurers purchase bonds almost entirely in the secondary market upon an increase in premiums. I follow prices over time at the bond level, eliminating time-invariant differences across bonds. The empirical specification compares the bond return of firms that face large premium-driven bond purchases with similar bonds from other firms,

$$\begin{aligned}\text{Bond return}^{-1:x}_{b,t} =& \alpha \frac{\text{Bond purchases}_{f(b),t}}{\text{Bond debt}_{f(b),t-1}} + \Gamma' C_{b,t} + u_b + v_{\text{Maturity,Rating},t} \\ &+ w_{\text{Industry},t} + y_{\Delta\text{Rating}} + \varepsilon_{b,t}, \end{aligned} \tag{5}$$

where firm $f(b)$ is the issuer of bond b and $C_{b,t}$ is a vector of control variables containing the firm and insurer characteristics listed in Table 5. The regression is at the bond-by-quarter level. Bond $\text{return}^{-1:x}_{b,t}$ is the bond return based on end-of-month prices and accrued interest between months $fmoq(t) - 1$ and $fmoq(t) + x$, where $fmoq(t)$ is the first month of quarter t. Insurers' bond purchases are instrumented by firms' exposure to increases in potential investors' premiums, $\Delta\text{INVPremiums}^{>0}_{f,t}$. Bond fixed effects, u_b, capture time-invariant heterogeneity at the bond level. (Remaining time to) Maturity bucket-by-credit rating-by-time fixed effects, $v_{\text{Maturity,Rating},t}$, capture differences in return trajectories depending on bonds' time to maturity (with bins separated at 5, 10, and 15 years) and credit rating. Additional fixed effects control for cross-industry differences at the 2-digit SIC level, $w_{\text{Industry},t}$ and for the effect of credit rating changes, $y_{\Delta\text{Rating}}$, which correlate with insurers' investment behavior due to regulation (Ellul et al., 2011). Standard errors are clustered at the firm and region-by-time levels.

Figure 1 displays the estimated coefficient α for local projections (Jordá, 2005) with the specification of Equation (5), varying the time horizon of bond returns, x, on the x-axis. Bond returns increase by up to 54 bps when insurers' bond purchases increase by 1% of the firm's outstanding bonds (which is close to the average amount of quarterly bond purchases). This estimate is equivalent to a decrease in yields by 10 bps (=0.54/5.19), using the median bond duration, and it is robust across different empirical specifications (see Appendix Table IA.22). Prices remain elevated for 4 months and start to revert afterwards. After 6 months, prices have fully reverted, which means that the coefficient on instrumented bond purchases is close to and not significantly different from zero. The speed of this price reversal is similar to that in other studies of nonfundamental demand shifts in the corporate bond market (e.g., Massa and Zhang, 2021; Ellul et al., 2011), and it is consistent with models of price pressure, e.g., due to search-and-bargaining frictions (Duffie et al., 2007). The figure also shows that prices *before* an increase in demand do *not* significantly differ across firms. Overall, these results strongly support the identification strategy: They are consistent with as-good-as-random matching of firms and insurers, and rule out an increase in bond supply as an alternative explanation.

The estimated magnitude is consistent with previous studies of bond price pressure (Ellul et al., 2011; Massa and Zhang, 2021) and economically sizable. The magnitude corresponds to more than twice the average transaction cost of corporate bond trades estimated in prior studies, which suggests that investor demand shocks amplify OTC market frictions.[22]

The estimate from Equation (5) can be used to approximate the price elasticity of demand for bonds. Using the peak price impact at $x = 3$, $\alpha = 54$, the implied elasticity is $-1/(\alpha/100) = -1.9$. This estimate for the elasticity of bonds is larger (in absolute value) than most estimates for that of stocks.[23] Intuitively, bonds are more easily substitutable than stocks, especially when they have a high credit rating, which suggests a larger elasticity

[22] O'Hara et al. (2018) estimate an average transaction cost of 17 bps for bond purchases by comparing the bond prices of less and more active investors. Chakravarty and Sarkar (2003) estimate a bid-ask spread of 21 bps by comparing average dealer sell and buy prices. Bessembinder et al. (2006) estimate the one-way trade execution costs for institutional bond trades to be 9 bps using a structural model.

[23] Recent estimates for the price elasticity of demand for stocks are -1 by Koijen and Yogo (2019), -1.25 by Schmickler (2021), -1.46 by Chang et al. (2014), and -3.7 by Pavlova and Sikorskaya (2022).

for bonds than for stocks. Nonetheless, over-the-counter market frictions, such as costly search, may reduce price elasticity in the bond market (Duffie et al., 2007; Friewald and Nagler, 2019).

5.2 Primary market

The impact of the secondary market on firms' cost of capital depends on the extent to which it affects investors' willingness to pay for new bond issuances in the primary bond market. Below, I investigate this channel. Since each bond appears only once in the primary market, the identification relies on variation in the cross-section of firms conditional on bond issuance. Specifically, I compare the issuance yield spread of firms that face large premium-driven bond purchases with that of similar firms that face smaller purchases,

$$\begin{aligned}\text{Yield spread}_{f,t} =& \alpha \log(\text{Bond purchases}_{f,t}) + \Gamma' C_{f,t} + u_{\text{Maturity},t} \\ &+ v_{\text{Rating},y(t)} + w_{\text{Broad industry},y(t)} + \varepsilon_{f,t},\end{aligned} \tag{6}$$

where the yield spread is relative to treasuries with the closest remaining time to maturity and averaged across issuances of the same firm in the same quarter weighted by offering amounts. To accommodate the log-linear relation between yield spreads and bond purchases, I log-transform the instrument as follows: $\Delta\widetilde{\text{INVPremiums}}^{>0}_{f,t} = \log(1 + \Delta\text{INVPremiums}^{>0}_{f,t} \times \text{Bond debt}_{f,t-1})$. Maturity bucket-by-quarter fixed effects, $u_{\text{Maturity},t}$, absorb time-varying differences in yield spreads across issuances with a different time to maturity. Rating-by-year, $v_{\text{Rating},y(t)}$, and 1-digit SIC industry-by-time fixed effects, $w_{\text{Broad industry},y(t)}$, account for differential trends of firms with different credit ratings or in different industries, respectively. These are at the yearly level (denoted by $y(t)$) to maintain meaningful variation in the dependent and explanatory variables. $C_{f,t}$ is a vector of control variables that includes the logarithm of a bond's time to maturity and the firm and insurer characteristics listed in Table 5. Standard errors are clustered at the firm and region-by-time levels.

The first column of Table 4 provides estimates for the model in Equation (6) including only control variables and maturity-level and rating-level fixed effects. I find a large and significantly negative (at the 1% level) coefficient on insurers' instrumented bond purchases. The point estimate implies that issuance yield spreads decrease by 0.38 bps when insurers' bond purchases increase by 1%. Columns (2) and (3) enrich the specification by including additional control variables and industry-by-year fixed effects, which has a negligible impact on the estimated coefficient and its significance. Column (5) provides further robustness, using firms' exposure to disasters at potential investors' location as an alternative instrument.

Using average bond purchases and lagged bond debt ($198 million and $5.6 billion in the sample of Table 4, respectively), the estimate implies that yields decrease by 9 to 12 bps when insurers' bond purchases increase by 1% of the firm's outstanding bonds. This magnitude resembles the price impact in the secondary market. To narrow in on the transmission from insurers' secondary market purchases to the primary market, in column (4) I additionally control for insurers' primary market purchases. However, this does not meaningfully reduce the estimate for α, which remains significantly positive. Thus, the impact on issuance yields is driven by insurers' bond demand in the secondary and not that in the primary market. The pass-through from the secondary to the primary market is consistent with investors learning from secondary market prices (Grossman, 1976; Hellwig, 1980; Glebkin and Kuong, 2022) and exploiting arbitrage opportunities.

The yield impact of 9 to 12 bps, which associates with insurers' average bond purchases (of 1% of a firm's bonds), is also economically significant. For example, it corresponds to roughly half of the difference between issuance yield spreads of issuers with a BBB+ and AAA- credit rating (which is 24 bps in my sample), to one quarter of the announcement effect of the European Central Bank's corporate bond purchase program (Grosse-Rueschkamp et al., 2019), and twice as large as the impact of actual purchases by the Federal Reserve in the context of its corporate credit facilities in 2020 (Boyarchenko et al., 2022).

6 Bond financing and bond demand

The previous section documents that insurers' bond demand affects firms' financing costs. In the following, I present the paper's main results, which investigate firms' response to investor demand shifts. I start with an analysis of bond financing activities.

6.1 Baseline specification

To examine the effect of insurers' premium-driven bond purchases on firms' bond debt, I estimate Equation (1) with a firm's net bond issuance as the dependent variable and with firms' exposure to increases in potential investors' premiums as the instrument for insurers' bond purchases. The empirical specifications include fixed effects at the region-by-time level, which absorb changes in a firm's local economic environment (which is either the U.S. Mid-Atlantic, Midwest, Northeast, Southeast, Southwest, or West). Firm-seasonality fixed effects absorb time-invariant firm characteristics and seasonality in bond issuance and insurance premiums by interacting firm dummies with calendar quarter dummies. Industry-by-time fixed effects absorb industry-wide shocks at the 2-digit SIC level. Additionally, firm-level control variables capture traditional determinants of corporate finance, namely, current sales and cash flow, to control for internal funding (e.g., Frazzari et al., 1988, Almeida et al., 2004), the market-to-book ratio as a measure of (expected) investment opportunities, and firm age, leverage, cash holdings, and cash growth to control for financial slack (see Appendix Table IA.9 for detailed definitions).

Additionally, I control for the characteristics and economic environment of a firm's potential investors. Specifically, for each firm-quarter, I calculate the average potential investor's P&C and life insurance profitability, life insurance fee income, investment yield, and return on equity and size. These variables capture variation in insurance supply and insurers' investment success and profitability. Moreover, I include the share of life insurers among potential investors as a measure for investor composition. To control for insurers' economic environment, I include granular fixed effects that absorb differential trends between firms with potential investors in different lines of business or in different locations. These are at the insurer type level (based on the share of lagged insurance premiums written by line of business) and insurer location level (based on the share of lagged insurance premiums written by region), all interacted with time dummies.

Finally, I compute dummy variables based on the level of employment in the firm's industry and the level of consumption by consumption type at the location of potential investors' customers (for a detailed description, see Appendix Table IA.9). Fixed effects based on the interaction of these dummies with time dummies (referred to as *insurer economy-by-time fixed effects*) absorb time-varying differences between firms that correlate with consumption or employment patterns in potential investors' location. Including these fixed effects ensures that the estimate compares firms with similar levels of industry-specific employment and consumption in the states where potential investors' customers are located, alleviating the concern that insurers might invest in firms with local ties.

6.2 Baseline results

Panel A in Table 5 reports the estimated coefficient for different specifications. Column (1) includes firm-seasonality, industry-by-time, and region-by-time fixed effects. In columns (2) and (3), I successively add the additional fixed effects and controls described above. As a robustness check, in columns (4) I use firms' exposure to disasters at potential investors' location as an alternative instrument. In all specifications, the coefficient on insurers' instrumented bond purchases is significantly positive at the 1% level. Saturating the specification with controls and fixed effects has a negligible effect on the point estimate and its significance, supporting the identification strategy.

The point estimate in the most refined specification (3) implies that a firm's net bond issuance increases by 6.27% when insurers' bond purchases increase by 1%, both relative to the firm's outstanding bonds. The large first-stage F statistic, which is well above 20, suggests that the estimate is not contaminated by weakness of the instrument. Instead, the order of magnitude is consistent with prior studies.[24] It jointly reflects the elasticity of firms to bond prices and insurers' price impact: The larger the price impact of insurers' bond purchases, the stronger are firms' incentives to issue bonds. The fact that the estimated coefficient exceeds unity suggests that firms' response on average exceeds insurers' purchases. Importantly, this result is driven by insurers' bond purchases in the *secondary* market: In columns (5) and (6), I additionally control for insurers' primary market activity, which has little effect on the coefficient. Thus, bond issuance in the primary market responds to insurers' demand in the secondary market. These findings are consistent with a model in which learning from secondary market prices (Grossman, 1976; Hellwig, 1980; Glebkin and Kuong, 2022) raises the willingness to pay for new bond issuances in the primary market.[25]

To interpret the first stage coefficients, it is useful to compute the average premium increase (of $\max\{\Delta \log \overline{P}_{f,t}, 0\}$), which is 0.06, and its standard deviation, which is 0.14. Due to the scaling of the instrument (see Section 4), for firms with an average exposure

[24] For instance, Dathan and Davydenko (2020) estimate that a $\frac{0.12}{0.63}$ ppt increase in demand by passive bond funds associates with a 12 bps decline in yield spreads and a $\frac{0.12}{0.63} \times 26.91 = 5.13$ ppt increase in total debt growth.These estimates are quantitatively similar to the estimated impact of the purchase of 1% of a firm's bonds in Tables 4 and 5.

[25] Investor segmentation (Siani, 2022) and changes in expected secondary market liquidity (Goldstein et al., 2019; Sverchkov, 2020) may amplify primary market elasticity. Issuance volumes may be lumpy due to fixed issuance costs (Bolton et al., 2013).

to insurers the first stage coefficient in specification (3) implies bond purchases of 0.14% ($= 0.024 \times 0.06$) of outstanding bonds for the average premium increase, and an increase in purchases by 0.34% ($= 0.024 \times 0.14$) of outstanding bonds for a 1-standard-deviation-increase. Hence, the identification leverages coarse variation in insurers' bond demand. Jointly with the second-stage coefficient, an average premium increase associates with net bond issuance of 0.9% ($= 6.27 \times 0.024 \times 0.06$) of bonds. These magnitudes are similar for the instrument based on natural disasters, as an average increase in fatalities (of $\max\{\Delta \log \overline{D}_{f,t}, 0\}$), which is 0.43, associates with bond purchases of 0.17% ($= 0.43 \times 0.004$) and net bond issuance of 1.3% ($= 7.31 \times 0.43 \times 0.004$) of bonds.

6.3 Alternative specifications

I assess the robustness of the baseline results in two ways. First, in Appendix Table IA.23 I estimate a battery of alternative specifications. These include additional firm controls, parametric and nonparametric controls for insurers' profitability and investment success, and state-by-industry-by-time and credit rating-by-time fixed effects. I also use fixed effects based on the social connectedness between a firm's location and the location of its potential investors' customers as a proxy for unobserved economic ties across regions, such as trade or common cultural values (Bailey et al., 2018). The results are also robust to alternative definitions of the instrument, using a 10-quarter (instead of an 8-quarter) time horizon to define potential investors, excluding insurance premiums from the states neighboring a firm's location, and excluding insurance premiums from states in which a firm's suppliers and customers are located (Barrot and Sauvagnat, 2016).

Second, I compare bond to commercial paper issuance. Similar to corporate bonds, commercial paper is publicly traded debt. It is an important component of firms' capital structure and often used to finance investment (Kahl et al., 2015). The share of commercial paper relative to total debt is 8.23% on average in the sample and ranges up to 30.5% at the 95th percentile (see Appendix Table IA.19). In contrast to corporate bonds, commercial paper has short maturities of 45 days on average (Ou et al., 2004). For this reason, long-term investors such as insurance companies are barely active in this market, investing less than 1% of their assets in commercial paper (Source: Z.1 Financial Accounts of the U.S.). Therefore, it is reasonable to assume that cross-sectional variation in commercial paper demand is uncorrelated with potential investors' insurance premiums. Building on this assumption, I estimate the effect of insurers' instrumented bond purchases on firms' bond issuance *relative* to their commercial paper issuance at the debt type-by-firm-by-quarter level:

$$\frac{\Delta \text{Debt}_{d,f,t}}{\text{Bond debt}_{f,t-1}} = \alpha \frac{\text{Bond purchases}_{f,t}}{\text{Bond debt}_{f,t-1}} \times 1\{\text{Bond}_d\} + u_{f,t} + v_{f,d} + w_{d,t} + \varepsilon_{d,f,t}, \qquad (7)$$

where d denotes the debt type (either corporate bonds or commercial paper), $\Delta\text{Debt}_{d,f,t}$ is the quarterly change in debt outstanding (i.e., net issuance) of type d, and $1\{\text{Bond}_d\}$ is an indicator for corporate bond debt. α is the effect of insurers' bond purchases on firms' bond issuance relative to commercial paper issuance. Bond purchases are instrumented with $\Delta\text{INVPremiums}^{>0}_{f,t}$. The important difference from the baseline specification is the inclusion of firm-by-time fixed effects, $u_{f,t}$, which absorb any firm-specific shocks, e.g., stemming from changes in investment opportunities. Thus, α is identified from variation *within* the same firm at the same point in time. I also include debt type-by-firm fixed effects, $v_{f,d}$, which absorb time-invariant heterogeneity in firms' debt structure, and debt type-by-time fixed effects, which absorb debt type-specific shocks, such as shocks to the commercial paper or corporate bond market environment. Standard errors are clustered at the firm and debt type-by-time levels. To estimate Equation (7) I consider only the subsample of firms for which commercial paper is a relevant source of corporate finance, defined as those with positive commercial paper debt in at least one quarter from 2010q1 to 2018q4.

The first column of Panel B in Table 5 estimates Equation (7) without firm-by-time fixed effects. The point estimate for the coefficient on insurers' bond purchases is significantly positive with a magnitude similar to that in the baseline results in Panel A. Column (2) additionally includes firm-by-time fixed effects, which have a modest impact on the coefficient. This rules out firm-specific determinants of bond supply as an alternative explanation. Confirming the robustness of the result, column (3) uses firms' exposure to disasters at potential investors' location as an alternative instrument, which slightly elevates the coefficient of interest similarly to Panel A. Finally, columns (4) and (5) focus on the subsample of firms with positive commercial paper debt in at least 50% of quarters. In all specifications, the coefficient is highly significantly positive with a magnitude close to that in Panel A.

6.4 The role of financial conditions

Increases in insurers' bond demand motivate firms to exploit favorable funding conditions, which is a form of *corporate opportunism* (Baker, 2009). This opportunism may be amplified by the presence of financial constraints, that prevent firms from pursuing all desired projects, and alleviated by loose financial conditions, that lower average funding costs.[26] To explore such heterogeneity across firms, I use several proxies for financial conditions. Hadlock and Pierce (2010) propose the size-age (SA) index as a measure for financial constraints, which loads negatively on firm age and positively on squared size.[27] Additionally, I examine heterogeneity across firms with different sizes, profitability, measured by cash flow, and credit ratings.

Observing insurers' actual bond purchases allows to disentangle heterogeneity in firms' response to an increase in bond demand (second stage) from heterogeneity in insurers' reaction to premium inflows (first stage). This approach differs from that in previous studies that do not observe security transactions (e.g., Zhu, 2021) and is essential for the interpretation of the results. For example, insurers might purchase significantly more bonds issued by large than by small firms (first stage), but large and small firms might not react differently to an increase in bond demand (second stage).

I first sort firms into bins based on cross-sectional terciles of firm characteristics and rating categories, and then estimate separate coefficients on insurers' instrumented bond purchases for each bin following specification (3) in Table 5. Additionally, I include tercile (or rating) fixed effects, which control for heterogeneity across firms with different characteristics. Table 6 reports the estimated coefficients. There are significant differences in the sensitivity of insurers' bond purchases in the first stage regressions in columns (5) to (8). Insurers purchase significantly more bonds issued by larger firms upon a premium increase, while purchases of small firms' bonds do not significantly react. Consistent with Acharya et al. (2021)'s finding that investors subsidize firms with a BBB rating, the effect of premiums on bond purchases is particularly large for these firms.

Instead, the second stage regressions in columns (1) to (4) suggest that financial con-

[26]The banking literature highlights the financial constraints channel for the transmission of credit supply shocks from banks to firms (Chava and Purnanandam, 2011; Chodorow-Reich, 2014).

[27]Hadlock and Pierce (2010) evaluate the use of firm characteristics to measure financial constraints based on qualitative evidence from SEC filings. They provide evidence that the SA index reflects financial constraints more accurately than the KZ index from Kaplan and Zingales (1997).

ditions have little effect on the responsiveness of firms' bond issuance. Differences across firms with different financial constraints, size, or profitability are statistically insignificant. Consistent with these results, credit ratings do also not have a monotonic effect on firms' responsiveness. Instead, the coefficient is particularly large for firms with a very high (AAA-A) or low (high yield) credit rating but significantly smaller for those with an intermediate (BBB) rating. A potential reason for this difference is that firms with an intermediate rating already benefit from high levels of investor demand on average (Acharya et al., 2021) and therefore might respond less markedly to additional demand increases.

Overall, the results suggest that opportunistic bond issuance is not amplified by weak financial conditions. Instead, differently constrained firms tend to find it equally attractive to exploit the favorable funding conditions resulting from an increase in insurers' bond demand. A potential reason for this result is that firms with bond market access are, on average, relatively unconstrained (Faulkender and Petersen, 2006; Cantillo and Wright, 2000).

6.5 The underwriter channel

Why are firms so responsive to investor demand? According to anecdotal evidence I collected from a large nonfinancial firm and investment bank, investors do typically not communicate demand shifts directly to firms. Instead, investors have close ties with investment banks, which inform firms about investor demand and help firms set issuance prices and allocate orders in their role as underwriters.

Consistent with this anecdotal evidence, I first document that firm-underwriter relationships are very persistent. On average, 74% of bond issuance volumes in my sample involves bond underwriters that a firm has worked with in the previous year. An average issuance involves approximately 4 underwriters.

Bond underwriters are investment banks, which also act as dealers in the secondary bond market. Insurer-dealer relationships are similarly persistent. On average, 73% of insurers' bond purchases (at par value at the insurer-quarter level) are from dealers that they worked with in the previous year. The insurer-dealer network is fragmented, as insurers work with only 17 dealers on average.[28]

[28] Hendershott et al. (2020) propose a model in which insurers build relationships with dealers to mitigate search frictions in the bond market. Appendix Figure IA.21 displays the cross-sectional distribution of persistence in firm-underwriter and insurer-dealer relationships.

I use the overlap between a firm's relationship underwriters and potential investors' relationship dealers as a measure of how connected a firm's underwriters are with potential investors. Specifically, I define $\mathbb{I}(\text{Underwriter}_{u,f,t-(1:4)})$ as an indicator for whether underwriter u ever participated in firm f's bond issuances in the past 4 quarters. Then, I measure the connectedness of the firm's underwriters with potential investors as the share of potential investors' bond purchases from the firm's underwriters in the previous 4 quarters,

$$\%\text{UW}_{f,t} = \frac{\sum_i \mathbb{I}(\text{Investor}_{i,f,t-(1:8)}) \sum_u \sum_{k=1}^{4} \mathbb{I}(\text{Underwriter}_{u,f,t-(1:4)}) \text{Bond purchases}_{i,u,t-k}}{\sum_i \mathbb{I}(\text{Investor}_{i,f,t-(1:8)}) \sum_u \sum_{k=1}^{4} \text{Bond purchases}_{i,u,t-k}}, \quad (8)$$

where $\text{Bond purchases}_{i,u,t-k}$ represents insurer i's total bond purchases from underwriter u in quarter $t-k$. Finally, $\text{UW}_{f,t}$ is an indicator for high connectedness of underwriters with potential investors, which equals one if $\%\text{UW}_{f,t}$ exceeds the 20th percentile of its cross-sectional distribution (which on average corresponds to 0.25) and zero otherwise. Since the measure relies on the subset of bond purchases with identified counterparties, the number of firms in the sample drops to 489.

To test the underwriter channel, I regress firms' net bond issuance on the interaction of insurers' instrumented bond purchases and $\text{UW}_{f,t}$. Column (1) in Table 7 reports the results. The coefficient on the interaction term is large and significant. Thus, consistent with the hypothesis, firms respond significantly more strongly to an increase in bond demand when their underwriters are well connected with potential investors.

A possible alternative explanation for the result in column (1) is that firms with well-connected underwriters are different along other dimensions. To the extent that such differences are time-invariant or seasonal, they are absorbed by controlling for $\text{UW}_{f,t}$ and including firm-seasonality fixed effects. Column (2) additionally controls for firm and insurer characteristics, and column (3) includes $\text{UW}_{f,t}$-by-time fixed effects, which absorb time-varying differences across firms with more- and less-connected underwriters. Both modifications have a modest effect on the coefficient of interest. Column (4) shows that the underwriter effect is concentrated around the two lowest quintiles of $\%\text{UW}_{f,t}$. Thus, the marginal benefit of underwriter connectedness is decreasing with its level.

Finally, I provide further evidence on the mechanism behind the underwriter channel. The hypothesis states that underwriters are relevant because they disseminate information about investor demand to firms. In this case, one would expect underwriter connectedness to become more important when information is more difficult to gather. I use the dispersion of a firm's investors, measured as the negative of the Herfindahl-Hirschman index of insurers' holdings of the firm's bonds, and the number of a firm's potential investors as proxies for information barriers. To test the relevance of information barriers, I expand the regression model with a triple interaction term of insurers' instrumented bond purchases, $\text{UW}_{f,t}$, and a dummy variable for strong information barriers, which flags the upper tercile of the cross-sectional distribution of investor dispersion or number of potential investors. The model also includes all related two-way interactions and the variables themselves. The coefficient on the triple interaction term is large and significantly positive for both proxies for information barriers (see columns 5 and 6), consistent with the hypothesis. These results emphasize the role of underwriters for corporate opportunism.

7 Corporate investment and bond demand

The previous section provides evidence that firms respond to increases in insurers' bond demand by raising net bond issuance. In this section, I explore whether the additional funding is used for corporate investment.

7.1 Baseline results

To examine the effect of insurers' premium-driven bond purchases on corporate investment, I estimate Equation (1) with variables that reflect investment activities as dependent variables. I define total investment as the sum of acquisition and capital expenditures scaled by lagged bond debt.[29] Additionally, I explore the growth in firms' tangible assets (PPE) and total assets. The empirical specification is analogous to that in Panel A in Table 5.

Panel A in Table 8 reports the baseline results. The main result in column (1) shows a significantly positive coefficient on insurers' instrumented bond purchases for firms' total investment. The point estimate implies that a firm's investment increases by 6.11% when insurers' bond purchases increase by 1%, both relative to the firm's outstanding bonds. The magnitude of this effect is similar to that on net bond issuance (Table 5), suggesting that

[29] Acquisition expenditures represent the cash outflow of funds used for and/or costs that relate to acquisitions, including the acquisition price and additional costs. Acquisitions are relatively frequent among the firms in my sample, as acquisition expenditures are positive in one-third of firm-quarter observations.

a considerable fraction of opportunistic bond issuance proceeds fund investment activities. The result is robust to using firms' exposure to disasters at potential investors' location as an alternative instrument in column (2).

Columns (3) to (6) delve into *how* firms invest. I find that both acquisition and capital expenditures significantly increase with insurers' instrumented bond purchases. The sensitivity of acquisition expenditures is roughly twice as large as that of capital expenditures. The strong response of acquisition expenditures is consistent with the fact that firms with bond market access are relatively mature (Cantillo and Wright, 2000) and, therefore, may face fewer direct investment opportunities than other, more bank-reliant firms. Again, the results are robust to using firms' exposure to disasters at potential investors' location as an alternative instrument. Finally, I also document a significant increase in tangible and total asset growth in columns (7) and (8). The estimated response of total asset growth is close to that of total investment, consistent with balance sheet dynamics.

I confirm the robustness of the results using a variety of alternative empirical specifications in Appendix Tables IA.24 to IA.26. In particular, the coefficients on total investment, acquisition expenditures, and capital expenditures are similar in magnitude and significance to the baseline results when using alternative definitions of the instrument and when including granular controls for insurers' investment success and profitability and fixed effects at the state-by-time and state-by-industry-by-time levels. Moreover, consistent with the previous findings, the results are also robust to controlling for insurers' primary market activity, emphasizing the role of secondary market demand.

7.2 Underinvestment vs. free cash flow problems

The response of investment to bond demand shifts is potentially consistent with underinvestment, since additional external finance relaxes financing frictions (Grossman, 1984; Holmstrom and Tirole, 1997), or with free cash flow problems, since additional external finance allows managers to pursue unprofitable investment projects (Jensen, 1986; Hart and Moore, 1995). To shed light on these potential channels, I exploit cross-sectional variation in the level of firms' financial constraints and evidence from firms' equity prices.

First, I explore the role of financing frictions, using Hadlock and Pierce (2010)'s SA index as a measure for the level of financial constraints. Columns (1) to (4) in Panel B in Table 8 report firms' investment response separately for firms in the lower, intermediate, and upper cross-sectional terciles of the SA index. To make sure that the coefficients do not pick up cross-sectional differences in average investment, the empirical specification includes fixed effects for each SA index tercile. The results consistently display a stronger response of more financially constrained firms, namely a larger increase in total investment, acquisition and capital expenditures, and tangible asset growth, respectively. The difference between firms in different SA index terciles is close to being significant, with p-values near 10% for total investment and acquisition expenditures and a p-value of 8% for tangible asset growth. The low level of financial constraints of firms with bond market access likely weakens the statistical power of these tests.[30]

The observation that less financially constrained firms respond less in terms of investment but similarly in terms of net bond issuance (see Table 6) suggests that they substitute other financing sources. Consistent with this interpretation, column (5) shows that firms in the lowest SA index tercile reduce "other debt" upon an increase in insurers' instrumented bond purchases (this category in Capital IQ includes debt not classified as bonds or bank debt, such as deposits and asset-backed securities). Instead, other debt of more constrained firms does not significantly respond.

Second, I explore firms' quarterly stock return (between end-of-quarter prices at $t-1$ and t) as a proxy for changes in their profitability. Column (6) reveals that stock returns respond significantly negatively to insurers' instrumented bond purchases for firms with intermediate financial constraints, while the response is muted in terms of economic and statistical significance for firms with lower or higher financial constraints.

Overall, these results suggest the presence of both underinvestment and free cash flow problems. Increases in insurers' bond demand alleviate financing frictions for the most financially constrained firms, which raise investment aggressively in response, consistent with underinvestment. Firms with intermediate financial constraints also significantly raise investment, but the significantly negative stock market reaction suggests that these marginal investments are unprofitable, consistent with free cash flow problems. Finally, the least financially constrained firms raise investment to a lesser extent and, instead, significantly substitute other sources of financing. Jointly with an economically and statistically insignif-

[30] The SA index ranges from -4.63 to -3.35 in the baseline sample and from -4.57 to 0.25 for U.S. nonfinancial firms in Compustat, respectively at the 5% and 95% percentiles.

icant stock market reaction, this evidence points to both weak underinvestment and weak free cash flow problems for these firms.

7.3 Shareholder payouts

Additionally, I explore whether shareholder payouts respond to insurers' premium-driven bond purchases. Recent studies emphasize that payouts are often financed by debt (Farre-Mensa et al., 2021), especially when bond prices are high (Ma, 2019). However, in Appendix Table IA.21 I find that increases in bond demand do not significantly raise payouts on average. Only in the absence of acquisitions the effect becomes economically and statistically significant (at the 10% level). This finding suggests that firms' response to bond demand shifts is partly driven by the availability of acquisition opportunities. Yet, the response of payouts remains economically small. Thus, bond price determinants other than transitory investor demand shifts likely underlie the correlation between shareholder payouts and bond prices documented in other studies.

8 Conclusion

Nonfinancial firms heavily rely on bond financing, with the majority of corporate bonds held by institutional investors. Therefore, it is important to understand whether bond investors are solely "spare tires", absorbing capital demand shocks, or whether they impact corporate finance and investment themselves, and if so, to what extent and through what channels. These questions are particularly relevant and, at the same time, non-trivial in the context of secondary bond markets, which account for a large part of investors' transactions. Motivated by these considerations, this paper offers causal evidence that quantifies the effect of bond investor demand in the secondary market on firms' bond debt and investment, leveraging detailed data on bond transactions from the U.S. insurance sector.

To identify nonfundamental demand shifts, I construct a novel firm-level instrument that combines liquidity inflows to insurers from household insurance premiums with insurers' preference to persistently invest in the same firms. These demand increases are concentrated in the secondary bond market, in which they significantly raise bond prices. I document that this price impact transmits to firms' funding costs in the primary market, consistent with investors learning from prices. Firms respond opportunistically by issuing more bonds, especially when they have underwriters that are well connected with insurers. The elasticity is large, implying that net bond issuance increases by approximately 6% of the firm's outstanding bonds when insurers purchase 1% of outstanding bonds. The proceeds are, on average, used for investment activities rather than shareholder payouts. Heterogeneity across firms and evidence from stock market prices suggest that investor demand shifts may relax financial frictions for the most constrained firms but, at the same time, motivate less constrained firms to undertake less profitable investments.

The substantial elasticity of corporate activities to investor demand emphasizes the importance for economic analyses to explicitly consider investors and their price impact. The findings point to spillovers of regulation, such as capital requirements, on the real economy through investors' investment behavior and suggest significant effects of central bank interventions in secondary markets, in addition to announcement effects.

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Figure and Tables

Figure 1. Secondary market prices and insurers' bond demand.

The figure depicts the secondary market bond price dynamics of firms that face large premium-driven bond purchases in months $1, 2$, and 3 relative to others. Specifically, the figure plots the estimated price impact and its 90% confidence interval in bps for an increase in premium-driven bond purchases by 1% of a firm's bonds, estimated using the specification in Equation (5). The dependent variable is the bond return based on end-of-month prices and accrued interest between months $fmoq(t) - 1$ and $fmoq(t) + x$, where $fmoq(t)$ is the first month in quarter t. The time horizon of bond returns, x, is varied on the x-axis.

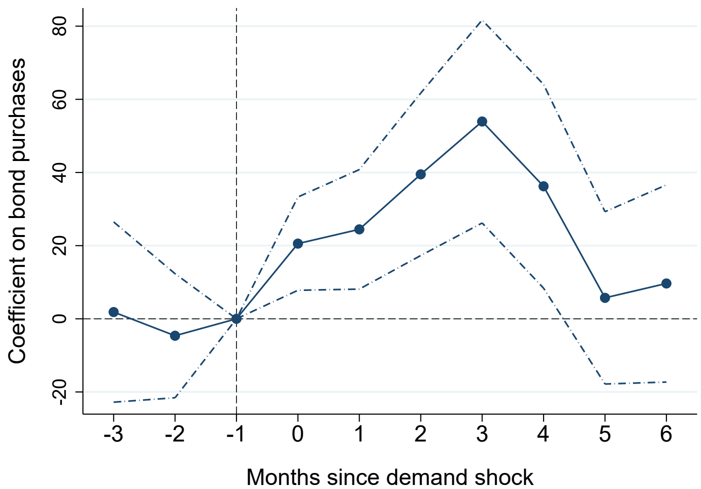

Table 1. Summary statistics.

Summary statistics at quarterly frequency from 2010q2 to 2018q4. Insurer-by-firm level statistics are based on a sample that includes all possible pairs of firms and insurers that are included in the baseline sample at a given point in time, and in this case the summary statistics for bond purchases are reported conditional on a purchase for readability. All variables are winsorized at the 1/99% levels.

	N	Mean	SD	p5	p50	p95
Insurer level (1,458 insurers)						
Bonds held (bil USD)	45,231	1.21	5.69	0.00	0.03	4.98
Bond purchases (mil USD)	45,231	51.33	257.43	0.00	1.38	209.54
Bond purchases/Total assets$_{t-1}$ (%)	45,231	1.63	2.38	0.00	0.83	6.26
Bond purchases (Prim)/Total assets$_{t-1}$ (%)	45,231	0.42	0.82	0.00	0.00	2.02
Bond purchases (Sec)/Total assets$_{t-1}$ (%)	45,231	1.09	1.93	0.00	0.33	4.79
Premiums (mil USD)	45,231	142.15	650.70	0.28	14.38	520.95
ΔPremiums/Total assets$_{t-1}$ (%)	45,231	0.24	3.39	-4.07	0.00	5.48
$100 \times \Delta$Disasters$^{>0}$	15,996	0.60	1.37	0.00	0.05	3.14
Insurer-by-firm level						
$100 \times \mathbb{I}$(Investor)	22,070,618	6.33	24.35	0.00	0.00	100.00
$100 \times 1\{$Purchase$\}$	22,070,618	0.45	6.68	0.00	0.00	0.00
Bond purchases (mil USD)	98,859	4.21	8.92	0.05	1.09	18.00
Firm level (871 firms)						
Bond debt/Total debt (%)	15,763	76.91	23.85	29.39	84.85	100.00
ΔBond debt/Bond debt$_{t-1}$ (%)	15,765	3.11	21.32	-12.58	0.00	31.82
%Held by insurers (%)	15,765	22.82	23.55	0.39	14.00	75.64
Bond purchases/Bond debt$_{t-1}$ (%)	15,765	0.96	2.53	0.00	0.11	4.45
ΔINVPremiums$^{>0}$ (%)	15,765	3.94	9.41	0.00	0.28	18.94
ΔINVDisasters$^{>0}$ (%)	15,490	38.29	70.29	0.00	5.23	187.84
Total investment/Bond debt$_{t-1}$ (%)	15,765	12.50	22.48	0.73	5.32	46.22
Acquisitions/Bond debt$_{t-1}$ (%)	15,765	4.23	16.74	0.00	0.00	21.37
CapEx/Bond debt$_{t-1}$ (%)	15,765	7.78	10.80	0.64	4.13	27.72
ΔTotal assets/Bond debt$_{t-1}$ (%)	15,765	9.37	43.78	-36.47	2.66	75.45
ΔPPE/Bond debt$_{t-1}$ (%)	15,765	2.53	12.46	-8.16	0.41	20.04
%UW	4,843	41.01	17.94	9.08	41.28	69.46
Issuance level: Primary market (399 firms)						
Yield spread (%)	1,017	2.41	1.87	0.49	1.63	6.28
Offering amount (bil USD)	1,017	1.35	2.20	0.23	0.60	5.00
Bond level: Secondary market (372 firms, 2,612 bonds)						
Bond return (%)	29,699	-0.05	3.13	-5.33	0.03	5.29
Transaction volume (mil USD)	29,699	52.28	86.10	1.09	23.88	193.71

Table 2. Insurance premiums, natural disasters, and insurers' bond purchases.
Each column presents estimated coefficients from a specification of the form:

$$Y_{i,t} = \alpha X_{i,t} + \Gamma' C_{i,t} + \varepsilon_{i,t}$$

at the insurer-by-quarter level, where $C_{i,t}$ is a vector of control variables and fixed effects. The dependent variable in columns (1) and (2) is the quarterly growth in insurer i's invested assets (including cash) scaled by lagged total assets, in columns (3) and (4) the par value of insurer i's corporate bond purchases scaled by lagged total assets, and in columns (5) and (6) the par value of insurer i's corporate bond purchases in the secondary market scaled by lagged total assets. In columns (1) to (5) the main explanatory variable is the quarterly growth in noncommercial insurance premiums scaled by lagged total assets and in column (6) exposure to disaster fatalities $\Delta\text{Disaster fatalities}^{>0}$. Column (6) only includes life insurers. The regressions distinguish between increases and decreases in premiums and disaster fatalities X, defined as $\Delta\text{X}^{>0} = \max\{\Delta\text{X}, 0\}$ and $\Delta\text{X}^{<0} = \min\{\Delta\text{X}, 0\}$. Insurer controls are an insurer's investment yield, P&C and life insurance profitability, life insurance fee income, credit rating dummies, and lagged return on equity. Seasonality dummies identify calendar quarters. t-statistics are shown in brackets and based on standard errors clustered at the insurer and region-by-time levels. ***, **, and * indicate significance at the 1%, 5%, and 10% levels.

	(1)	(2)	(3)	(4)	(5)	(6)
Sample:			Baseline			Life
Dependent variable:	$\frac{\Delta\text{Investments}}{\text{Total assets}_{t-1}}$		$\frac{\text{Bond purchases}}{\text{Total assets}_{t-1}}$		$\frac{\text{Bond purchases (Sec)}}{\text{Total assets}_{t-1}}$	
$\frac{\Delta\text{Premiums}}{\text{Total assets}_{t-1}}$	0.25***					
	[10.18]					
$\frac{\Delta\text{Premiums}^{>0}}{\text{Total assets}_{t-1}}$		0.42***	0.06***	0.06***	0.05***	
		[11.99]	[3.75]	[3.80]	[3.57]	
$\frac{\Delta\text{Premiums}^{<0}}{\text{Total assets}_{t-1}}$		-0.04	0.01	0.01	0.00	
		[-1.09]	[0.45]	[0.33]	[0.33]	
$\Delta\text{Disaster fatalities}^{>0}$						0.07***
						[3.48]
$\Delta\text{Disaster fatalities}^{<0}$						-0.01
						[-0.25]
Insurer controls				Y	Y	Y
Insurer-Seasonality FE	Y	Y	Y	Y	Y	Y
Life insurer-Time FE	Y	Y	Y	Y	Y	
Time FE						Y
No. of obs.	45,231	45,231	45,231	45,231	45,231	15,994
No. of insurers	1,458	1,458	1,458	1,458	1,458	505
Standardized coefficients						
$\frac{\Delta\text{Premiums}^{>0}}{\text{Total assets}_{t-1}}$		0.24	0.07	0.07	0.07	
$\frac{\Delta\text{Disasters}^{>0}}{\text{Total assets}_{t-1}}$						0.05
p-value for H0: Same coefficient on decreases and increases		0.00	0.07	0.05	0.06	0.04

Table 3. Persistence of insurers' portfolio allocation.
Each column presents OLS estimates from a specification of the form:

$$Y_{i,f,t} = \alpha \, \mathbb{I}(\text{Investor}_{i,f,t-(1:8)}) + \Gamma' C_{i,f,t} + \varepsilon_{i,f,t}$$

at the insurer-by-firm-by-quarter level, where $C_{i,f,t}$ is a vector of fixed effects. $\mathbb{I}(\text{Investor}_{i,f,t-(1:8)})$ flags potential investors and is equal to one if insurer i ever held bonds issued by firm f in the previous 1 to 8 quarters and zero otherwise. Columns (1) and (2) present estimates for the effect of $\mathbb{I}(\text{Investor}_{i,f,t-(1:8)})$ on the allocation of bond purchases and columns (3) to (5) for the effect of $\mathbb{I}(\text{Investor}_{i,f,t-(1:8)})$ and increases in insurance premiums on the volume of bond purchases, the latter both scaled by insurers' lagged total assets. The table also reports the implied relative effects of $\mathbb{I}$(Investor) and its interaction with a 1-standard-deviation increase in insurance premium increases, which are computed as the respective estimated coefficient scaled by $P(1\{\text{Purchase}\}|\mathbb{I}(\text{Investor}) = 0)$ in columns (1) and (2) and by $\mathbb{E}[\frac{\text{Bond purchases}}{10^{-6} \cdot \text{Total assets}_{t-1}}|\mathbb{I}(\text{Investor}) = 0]$ in columns (3) to (5). t-statistics are shown in brackets and based on standard errors clustered at the insurer and firm levels. ***, **, and * indicate significance at the 1%, 5%, and 10% levels.

	(1)	(2)	(3)	(4)	(5)
Dependent variable:	1{Purchase}		$\frac{\text{Bond purchases}}{10^{-6} \cdot \text{Total assets}_{t-1}}$		
$\mathbb{I}$(Investor)	0.03***	0.03***	10.10***	10.25***	9.85***
	[17.88]	[17.84]	[9.99]	[10.14]	[10.61]
$\frac{\Delta \text{Premiums}^{>0}}{10^{-3} \cdot \text{Total assets}_{t-1}}$			-0.00		
			[-0.02]		
$\mathbb{I}(\text{Investor}) \times \frac{\Delta \text{Premiums}^{>0}}{10^{-3} \cdot \text{Total assets}_{t-1}}$			0.22***	0.22***	0.23***
			[4.20]	[4.18]	[4.37]
Firm FE		Y	Y	Y	
Firm-Time FE	Y				Y
Insurer-Time FE	Y	Y		Y	Y
Insurer FE			Y		
No. of obs.	22,070,618	22,070,618	22,070,618	22,070,618	22,070,618
No. of insurers	871	871	871	871	871
No. of firms	1,480	1,480	1,480	1,480	1,480
Relative effect of $\mathbb{I}$(Investor)	14.00	14.00	2.57	2.61	2.51
Relative effect of $\mathbb{I}(\text{Investor}) \times sd\left(\frac{\Delta \text{Premiums}^{>0}}{10^{-3} \cdot \text{Total assets}_{t-1}}\right)$			1.24	1.26	1.30
$P(1\{\text{Purchase}\}|\mathbb{I}(\text{Investor}) = 0) = 0.002$, $\mathbb{E}[\frac{\text{Bond purchases}}{10^{-6} \cdot \text{Total assets}_{t-1}}|\mathbb{I}(\text{Investor}) = 0] = 3.93$					

Table 4. Primary market prices and insurers' bond demand.
Each column presents estimated coefficients from a specification of the form:

$$\text{Yield spread}_{f,t} = \alpha\, X_{f,t} + \Gamma' C_{f,t} + \varepsilon_{f,t}$$

at the firm-quarter level. The sample includes all firm-quarter observations with issuance activity and positive bond purchases by insurance companies. The dependent variable is the average offering yield spread (in %) of firm f at time t defined by the difference between the offering yield and the nearest-maturity treasury bond (using the average weighted by offering amount in case of multiple issues within the same firm-quarter). The main explanatory variable is the logarithm of insurers' purchases of firm f's bonds, log(Bond purchases$_{f,t}$). It is instrumented by the firm's log-transformed exposure to increases either in potential investors' premiums, $\Delta\widetilde{\text{INVPremiums}}^{>0} = \log(1+\Delta\text{INVPremiums}^{>0}\times\text{Bond debt}_{f,t-1})$, or in disaster fatalities at potential investors' locations, $\Delta\widetilde{\text{INVDisasters}}^{>0} = \log(1+\Delta\text{INVDisasters}^{>0}\times\text{Bond debt}_{f,t-1})$. $C_{f,t}$ is a vector of control variables and fixed effects, which includes the lagged share of firm f's bonds held by insurers (%Held by insurers$_{f,t-1}$) and the logarithm of bonds' time to maturity in each column. Maturity dummies are based on the remaining time to maturity in bins (0,5], (5,10], (10,15], (15,∞). Rating dummies identify the credit rating categories AAA-AA, A, BBB, BB, B, CCC, and unrated. Broad industry dummies are at the 1-digit SIC level. The definitions of other control variables and fixed effects are as in Table 5. The *Effect of purchasing 1% of bonds* is the implied impact of purchasing an 1% of a firm's outstanding bond debt relative to average purchases and lagged bond debt. t-statistics are shown in brackets and based on standard errors clustered at the firm and region-by-time levels. ***, **, and * indicate significance at the 1%, 5%, and 10% levels.

	(1)	(2)	(3)	(4)	(5)
Dependent variable:			Yield spread		
log(Bond purchases)	-0.38***	-0.41***	-0.49***	-0.43**	-0.39***
	[-2.89]	[-2.64]	[-3.10]	[-2.16]	[-3.36]
log(1 + Prim purchases)				0.05	
				[1.10]	
log(Time to Maturity)	Y	Y	Y	Y	Y
Insurer controls		Y	Y		
Firm controls			Y		
Maturity-Time FE	Y	Y	Y	Y	Y
Rating-Year FE	Y	Y	Y	Y	Y
Broad industry-Year FE			Y	Y	
First stage					
$\Delta\widetilde{\text{INVPremiums}}$	0.117***	0.098***	0.109***	0.081***	
	[5.23]	[4.83]	[4.89]	[4.42]	
$\Delta\widetilde{\text{INVDisasters}}$					0.156***
					[6.29]
F Statistic	34.4	24.9	28.8	23.0	54.6
No. of obs.	1,017	1,017	1,017	1,017	1,009
No. of firms	399	399	399	399	395
Effect of purchasing 1% of bonds	-0.09	-0.10	-0.12	-0.11	-0.10

Table 5. Corporate bond debt and insurers' bond demand.
Panel A presents estimated coefficients from specifications as in Equation (1) at the firm-by-quarter level. The dependent variable is net bond issuance. The main explanatory variable is the total volume of insurers' purchases of the firm's bonds in quarter t scaled by its lagged bond debt. It is instrumented by the firm's exposure to increases either in potential investors' premiums, $\Delta\text{INVPremiums}^{>0}$, or in disaster fatalities at potential investors' locations, $\Delta\text{INVDisasters}^{>0}$. Each column controls for the lagged share of the firm's bonds held by insurers. Firm controls are a firm's age and lagged sales, cash flow, cash, and cash growth, and market-to-book ratio and leverage ratio. Insurer controls are the share of life insurers among the firm's potential investors, the average potential investor's P&C and life insurance profitability, life insurance fee income, investment yield, lagged return on equity, and lagged size. Seasonality dummies identify calendar quarters. Industry dummies are at the 2-digit SIC level. Insurer type and location dummies reflect the lines of business and U.S. regions in which the firm's potential investors write insurance premiums, respectively. Insurer economy dummies are based on the number of employees in the firm's industry and consumption per capita at the firm's potential investors' customers' locations.
Panel B presents estimated coefficients from specifications of the form:

$$\frac{\Delta\text{Debt}_{d,f,t}}{\text{Bond debt}_{f,t-1}} = \alpha \frac{\text{Bond purchases}_{f,t}}{\text{Bond debt}_{f,t-1}} \times 1\{\text{Bond}_d\} + \xi' D_{d,f,t} + \zeta_{d,f,t}$$

at the debt type-by-firm-by-quarter level. Debt type d is either bond or commercial paper debt. The dependent variable is net debt issuance of type d relative to lagged bond debt. The main explanatory variable interacts a dummy for bonds with the instrumented total volume of insurers' purchases of the firm's bonds. The sample comprises firms with positive commercial paper debt in at least one quarter in columns (1) to (3), and at least 50% of quarters in (4) and (5). $D_{d,f,t}$ is a vector of fixed effects.
t-statistics are shown in brackets and based on standard errors clustered at the (A) firm and region-by-time or (B) firm and debt type-by-time levels. ***, **, and * indicate significance at the 1%, 5%, and 10% levels.

Panel A	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable:	$\frac{\Delta\text{Bond debt}}{\text{Bond debt}_{t-1}}$					
$\frac{\text{Bond purchases}}{\text{Bond debt}_{t-1}}$	5.71***	6.20***	6.27***	7.31***	5.87***	8.33**
	[3.62]	[4.03]	[4.10]	[2.70]	[5.05]	[2.19]
$\frac{\text{Bond purchases (prim)}}{\text{Bond debt}_{t-1}}$					-2.35	-6.08
					[-1.19]	[-1.01]
Firm controls		Y	Y	Y	Y	Y
Insurer controls		Y	Y	Y	Y	Y
Firm-Seasonality FE	Y	Y	Y	Y	Y	Y
Industry-Time FE	Y	Y	Y	Y	Y	Y
Region-Time FE	Y	Y	Y	Y	Y	Y
Insurer type-Time FE			Y	Y	Y	Y
Insurer location-Time FE			Y	Y	Y	Y
Insurer economy-Time FE			Y	Y	Y	Y
First stage						
$\Delta\text{INVPremiums}^{>0}$	0.024***	0.025***	0.024***		0.031***	
	[5.43]	[5.55]	[5.64]		[7.91]	
$\Delta\text{INVDisasters}^{>0}$				0.004***		0.003***
				[3.39]		[3.49]
F Statistic	97.1	102.4	90.9	32.9	555.4	66.3
No. of obs.	15,765	15,765	15,765	15,458	15,765	15,458
No. of firms	871	871	871	857	871	857
Effect of 1sd change in $\frac{\text{Bond purchases}}{\text{Bond debt}_{t-1}}$	0.14	0.16	0.16	0.19	0.15	0.21

Panel B	(1)	(2)	(3)	(4)	(5)
Dependent variable:			$\frac{\Delta \text{Debt}}{\text{Bond debt}_{t-1}}$		
Sample:	CP issuers			Frequent CP issuers	
$\frac{\text{Bond purchases}}{\text{Bond debt}_{t-1}} \times 1\{\text{Bond}\}$	7.04***	7.17***	11.08***	7.07***	11.03***
	[3.33]	[3.24]	[3.77]	[3.37]	[3.45]
Firm-Time FE		Y	Y	Y	Y
Firm-Debt type FE	Y	Y	Y	Y	Y
Debt type-Time FE	Y	Y	Y	Y	Y
First stage					
$\Delta\text{INVPremiums}^{>0} \times 1\{\text{Bond}\}$	0.047***	0.047***		0.056***	
	[3.87]	[3.28]		[3.13]	
$\Delta\text{INVDisasters}^{>0} \times 1\{\text{Bond}\}$			0.010***		0.010***
			[3.58]		[3.29]
F Statistic	34.0	34.0	66.7	33.3	51.1
No. of obs.	4,664	4,664	4,664	3,312	3,312
No. of firms	157	157	157	112	112

Table 6. Corporate bond debt and insurers' bond demand: The role of financial conditions. Table presents estimated coefficients from regressions of net bond issuance on insurers' corporate bond purchases scaled by lagged bond debt, which is instrumented by $\Delta\text{INVPremiums}^{>0}$. The coefficient varies in the cross-section of firms, which is split into terciles by either Hadlock and Pierce (2010)'s SA index for financial constraints, lagged total assets, lagged cash flow scaled by total assets, or credit rating (AAA-A, BBB, or high yield (HY)). Columns (5) to (8) report the first stage coefficients corresponding to columns (1) to (4), respectively. Controls are as in column (3) of Table 5 and additionally include tercile (or rating) dummies. t-statistics are shown in brackets and based on standard errors clustered at the firm and region-by-time levels. ***, **, and * indicate significance at the 1%, 5%, and 10% levels.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Second Stage Coefficient on $\frac{\text{Bond purchases}}{\text{Bond debt}_{t-1}}$				First Stage Coefficient on $\Delta\text{INVPremiums}^{>0}$			
Cross-section by	SA index	Size	Cash flow	Rating	SA index	Size	Cash flow	Rating
Terc1 / HY	6.80***	-8.62	6.40*	7.54**	0.03***	0.00	0.02**	0.02***
	[3.23]	[-0.57]	[1.86]	[2.51]	[4.51]	[0.34]	[1.97]	[2.71]
Terc2 / BBB	4.43**	8.70***	5.87*	3.46**	0.02***	0.03***	0.02**	0.04***
	[2.07]	[3.85]	[1.88]	[2.59]	[3.15]	[5.04]	[2.52]	[4.97]
Terc3 / AAA-A	8.50***	6.58***	7.75**	13.73***	0.02***	0.06***	0.02***	0.01**
	[3.16]	[5.11]	[2.37]	[2.76]	[2.90]	[6.06]	[2.94]	[2.43]
p-value for H0: Same coefficient on								
Terc1/HY & Terc2/BBB	0.38	0.28	0.89	0.22	0.10	0.00	0.97	0.13
Terc1/HY & Terc3/AAA-A	0.59	0.32	0.76	0.20	0.11	0.00	0.95	0.45
Terc2/BBB & Terc3/AAA-A	0.18	0.36	0.66	0.04	0.94	0.00	0.88	0.01

Table 7. Corporate bond debt and insurers' bond demand: The underwriter channel.

Table presents estimated coefficients from regressions of net bond issuance on insurers' corporate bond purchases scaled by lagged bond debt, which is instrumented by ΔINVPremiums$^{>0}$. UW$_{f,t}$ indicates whether firm f's underwriters are well connected with potential investors. UW:Quint x indicates whether the connectedness between underwriters and potential investors is in the x-th quintile. Dispersed INV indicates whether the Herfindahl-Hirschman index of insurers' lagged holdings of a firm's bonds is in the lower tercile of the cross-sectional distribution. Many INV indicates whether a firm's number of potential investors is in the upper tercile of the cross-sectional distribution. Other variables and fixed effects are defined as in Table 5. t-statistics are shown in brackets and based on standard errors clustered at the firm and region-by-time levels. ***, **, and * indicate significance at the 1%, 5%, and 10% levels.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable:	$\frac{\Delta\text{Bond debt}}{\text{Bond debt}_{t-1}}$					
$\frac{\text{Bond purchases}}{\text{Bond debt}_{t-1}}$	1.58	1.15	1.05		3.64*	3.95*
	[0.96]	[0.62]	[0.55]		[1.73]	[1.67]
$\frac{\text{Bond purchases}}{\text{Bond debt}_{t-1}}$ × UW	6.01***	6.24***	6.42***		3.89	2.86
	[3.00]	[3.28]	[3.34]		[1.34]	[0.98]
$\frac{\text{Bond purchases}}{\text{Bond debt}_{t-1}}$ × UW:Quint1				1.27		
				[0.64]		
$\frac{\text{Bond purchases}}{\text{Bond debt}_{t-1}}$ × UW:Quint2				9.45***		
				[2.92]		
$\frac{\text{Bond purchases}}{\text{Bond debt}_{t-1}}$ × UW:Quint3				9.47***		
				[3.03]		
$\frac{\text{Bond purchases}}{\text{Bond debt}_{t-1}}$ × UW:Quint4				5.28**		
				[2.27]		
$\frac{\text{Bond purchases}}{\text{Bond debt}_{t-1}}$ × UW:Quint5				9.04**		
				[2.38]		
$\frac{\text{Bond purchases}}{\text{Bond debt}_{t-1}}$ × UW × Dispersed INV					7.48*	
					[1.68]	
$\frac{\text{Bond purchases}}{\text{Bond debt}_{t-1}}$ × UW × Many INV						10.76***
						[2.76]
Omitted interactions					Y	Y
Firm & insurer controls		Y	Y	Y	Y	Y
Firm-Seasonality FE	Y	Y	Y	Y	Y	Y
Region-Time FE	Y	Y	Y	Y	Y	Y
Industry-Time FE	Y	Y	Y	Y	Y	Y
Insurer type-Time FE			Y	Y	Y	Y
Insurer location-Time FE			Y	Y	Y	Y
UW FE	Y	Y				
UW-Time FE			Y			
UW quintile-Time FE				Y		
UW-Dispersed INV-Time FE					Y	
UW-Many INV-Time FE						Y
First stage						
ΔINVPremiums$^{>0}$	0.067***	0.059***	0.056***	0.080***	0.055**	0.048**
	[2.66]	[3.07]	[3.04]	[3.63]	[2.52]	[2.34]
F Statistic	30.8	33.3	31.7	10.6	15.1	14.1
No. of obs.	4,824	4,824	4,824	4,824	4,824	4,824
No. of firms	489	489	489	489	489	489

Table 8. Corporate investment and insurers' bond demand.

Each column presents estimated coefficients from specifications as in Equation (1) at the firm-by-quarter level. The main explanatory variable is the total volume of insurers' purchases of the firm's bonds in quarter t scaled by its lagged bond debt. It is instrumented by the firm's exposure to increases either in potential investors' premiums, ΔINVPremiums$^{>0}$, or in disaster fatalities at potential investors' locations, ΔINVDisasters$^{>0}$. $C_{f,t}$ is a vector of control variables and fixed effects. It includes the lagged share of the firm's bonds held by insurers in each column. Control variables and fixed effects are defined as in Table 5.

Panel A presents average effects on firms' balance sheets and cash flows. The dependent variable in columns (1)-(2) is the firm's total investment (the sum of acquisition and capital expenditures), in columns (3)-(4) the firm's acquisition expenditures, in columns (5)-(6) the firm's capital expenditures, in column (7) the quarterly change in the firm's property, plant and equipment (PPE), in column (8) is the quarterly change in the firm's total assets, all scaled by lagged bond debt.

Panel B explores differences between firms with different levels of financial constraints, where SA:Terc1, SA:Terc2, and SA:Terc3 are indicators for the cross-sectional terciles of Hadlock and Pierce (2010)'s SA index. The dependent variable in column (1) is the firm's total investment, in column (2) the firm's acquisition expenditures, in column (3) the firm's capital expenditures, in column (4) the quarterly change in the firm's PPE, in column (5) the quarterly change in the firm's other debt, all scaled by lagged bond debt, and in column (6) the firm's quarterly stock return. The table also reports results from first stage regressions with $\frac{\text{Bond purchases}}{\text{Bond debt}_{t-1}} \times$ SA:Terc1 as dependent variable.

t-statistics are shown in brackets and based on standard errors clustered at the firm and region-by-time level. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

Panel A	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable:	$\frac{\text{Total investment}}{\text{Bond debt}_{t-1}}$		$\frac{\text{Acquisitions}}{\text{Bond debt}_{t-1}}$		$\frac{\text{CapEx}}{\text{Bond debt}_{t-1}}$		$\frac{\Delta\text{PPE}}{\text{Bond debt}_{t-1}}$	$\frac{\Delta\text{Assets}}{\text{Bond debt}_{t-1}}$
$\frac{\text{Bond purchases}}{\text{Bond debt}_{t-1}}$	6.11***	6.89***	3.34***	3.06*	1.33***	2.12*	2.12***	5.63**
	[3.97]	[2.79]	[2.70]	[1.75]	[3.83]	[1.96]	[3.38]	[2.05]
Firm controls	Y		Y		Y		Y	Y
Insurer controls	Y		Y		Y		Y	Y
Firm-Seasonality FE	Y	Y	Y	Y	Y	Y	Y	Y
Industry-Time FE	Y	Y	Y	Y	Y	Y	Y	Y
Region-Time FE	Y	Y	Y	Y	Y	Y	Y	Y
Insurer type-Time FE	Y	Y	Y	Y	Y	Y	Y	Y
Insurer location-Time FE	Y	Y	Y	Y	Y	Y	Y	Y
Insurer economy-Time FE	Y	Y	Y	Y	Y	Y	Y	Y
First stage								
ΔINVPremiums$^{>0}$	0.024***		0.024***		0.024***		0.024***	0.024***
	[5.64]		[5.64]		[5.64]		[5.64]	[5.64]
ΔINVDisasters$^{>0}$		0.004***		0.004***		0.004***		
		[3.39]		[3.39]		[3.39]		
F Statistic	90.9	32.9	90.9	32.9	90.9	32.9	90.9	90.9
No. of obs.	15,765	15,458	15,765	15,458	15,765	15,458	15,765	15,765
No. of firms	871	857	871	857	871	857	871	871
Standardized coefficient								
$\frac{\text{Bond purchases}}{\text{Bond debt}_{t-1}}$	0.69	0.79	0.51	0.47	0.31	0.50	0.43	0.33

Panel B	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable:	$\frac{\text{Total investment}}{\text{Bond debt}_{t-1}}$	$\frac{\text{Acquisitions}}{\text{Bond debt}_{t-1}}$	$\frac{\text{CapEx}}{\text{Bond debt}_{t-1}}$	$\frac{\Delta\text{PPE}}{\text{Bond debt}_{t-1}}$	$\frac{\Delta\text{Other Debt}}{\text{Bond debt}_{t-1}}$	Stock Return
$\frac{\text{Bond purchases}}{\text{Bond debt}_{t-1}} \times$ SA:Terc1	4.07***	2.35*	1.06***	1.15*	-3.79***	-0.70
	[2.84]	[1.90]	[2.82]	[1.77]	[-3.17]	[-1.36]
$\frac{\text{Bond purchases}}{\text{Bond debt}_{t-1}} \times$ SA:Terc2	5.79**	2.08	1.40**	2.30**	0.54	-3.41***
	[2.51]	[1.19]	[2.44]	[2.53]	[0.32]	[-2.84]
$\frac{\text{Bond purchases}}{\text{Bond debt}_{t-1}} \times$ SA:Terc3	11.58**	8.18**	1.82**	4.06**	-1.51	-1.37
	[2.52]	[2.29]	[2.26]	[2.47]	[-0.78]	[-0.86]
Firm controls	Y	Y	Y	Y	Y	Y
Insurer controls	Y	Y	Y	Y	Y	Y
Firm-Seasonality FE	Y	Y	Y	Y	Y	Y
Industry-Time FE	Y	Y	Y	Y	Y	Y
Region-Time FE	Y	Y	Y	Y	Y	Y
Insurer type-Time FE	Y	Y	Y	Y	Y	Y
Insurer location-Time FE	Y	Y	Y	Y	Y	Y
Insurer economy-Time FE	Y	Y	Y	Y	Y	Y
SA index tercile	Y	Y	Y	Y	Y	Y
First stage						
ΔINVPremiums$^{>0}$ $\times$ SA:Terc1	0.034***	0.034***	0.034***	0.034***	0.050***	0.034***
	[4.69]	[4.69]	[4.69]	[4.69]	[3.82]	[4.69]
F Statistic	23.5	23.5	23.5	23.5	12.7	23.5
No. of obs.	15,765	15,765	15,765	15,765	4,895	15,765
No. of firms	871	871	871	871	356	871
p-value for H0: Same coefficient for Terc1 and Terc3						
	0.12	0.12	0.37	0.08	0.30	0.68
p-value for H0: Same coefficient for Terc2 and Terc3						
	0.23	0.11	0.67	0.33	0.41	0.28

A Data and sample construction

Table IA.9: Variable definitions and data sources.

Note: *NAIC* refers to data from statutory filings to the National Association of Insurance Commissioners, which are retrieved from S&P Global Market Intelligence.

Variable	**Definition**
Insurer level	
Bonds held	Par value of corporate bonds (*Source: NAIC*)
Bond purchases	Par value of corporate bond purchases (*Source: NAIC*)
Premiums	Direct insurance premiums written (*Source: NAIC*)
ΔInvestments/Total assets$_{t-1}$	Quarterly change in the book value of total invested assets (including cash) scaled by lagged total assets (*Source: NAIC*)
Size	Natural logarithm of total assets (*Source: NAIC*)
Return on equity	Annualized income after taxes as a percentage of insurer's capital and surplus (*Source: NAIC*)
Investment yield	Annualized investment return based on invested assets (*Source: NAIC*)
# Firms held	Number of issuers (identified by 6-digit CUSIP) in an insurer's corporate bond portfolio (*Source: NAIC*)
P&C insurance profitability	Ratio of the difference between net premiums earned and losses and loss adjustment costs to total liabilities (*Source: NAIC*)
Life insurance profitability	Ratio of net income to direct insurance premiums written (*Source: NAIC*)
Life insurance fee income	Ratio of income from fees associated with investment management, administration, and contract guarantees from separate accounts to direct insurance premiums written (*Source: NAIC*)
Rating	Insurer's financial strength credit rating, numeric from 1 to 15 (*Source: AM Best*)
Insurer-by-firm level	
$\mathbb{I}$(Investor)	Indicator variable for whether in the previous 8 quarters the insurer has ever held bonds issued by the firm (*Source: NAIC*)
1{Purchase}	Indicator variable for whether in the current quarter the insurer has purchased bonds issued by the firm (*Source: NAIC*)
Bond purchases	Par value of corporate bonds purchased in the current quarter by the insurer issued by the firm (*Source: NAIC*)
Firm level	
ΔBond debt/Bond debt$_{t-1}$	Net bond issuance, measured as the quarterly change in bond debt (the sum of senior and subordinated bonds) scaled by lagged bond debt (*Source: Capital IQ*)
%Held by insurers$_{f,t-1}$	Ratio of the lagged total par value of the firm's bonds held by insurers relative to the firm's lagged bond debt (*Sources: Capital IQ, NAIC*)

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Table IA.9 – *Continued from previous page*

Variable	**Definition**
Bond purchases/Bond debt$_{t-1}$	Ratio of the total par value of the firm's bonds purchased by insurers relative to the firm's lagged bond debt (*Sources: Capital IQ, NAIC*)
ΔINVPremiums$^{>0}$	Maximum of zero and ΔINVPremiums defined in Equation (3) (*Sources: Capital IQ, NAIC*)
ΔINVDisasters$^{>0}$	Maximum of zero and ΔINVDisasters defined in Section 4.4 (*Sources: Capital IQ, NAIC, SHELDUS*)
Total investment/Bond debt$_{t-1}$	The firm's total investment (the sum of acquisition and capital expenditures) scaled by the firm's lagged bond debt (*Sources: Capital IQ, Compustat*)
Acquisitions/Bond debt$_{t-1}$	The firm's cash outflow used for acquisitions scaled by the firm's lagged bond debt (*Sources: Capital IQ, Compustat*)
CapEx/Bond debt$_{t-1}$	The firm's capital expenditures scaled by the firm's lagged bond debt (*Sources: Capital IQ, Compustat*)
ΔTotal assets/Bond debt$_{t-1}$	Quarterly change in the book value of the firm's total assets scaled by the firm's lagged bond debt (*Sources: Capital IQ, Compustat*)
ΔPPE/Bond debt$_{t-1}$	Quarterly change in the firm's net property, plant and equipment scaled by the firm's lagged bond debt (*Sources: Capital IQ, Compustat*)
%UW	Share of potential investors' bond purchases from the firm's underwriters in the previous 4 quarters, as defined in Section 6.5 (*Sources: NAIC, Mergent FISD*)
Size	Natural logarithm of the firm's total assets (*Source: Compustat*)
Asset growth	Quarterly change in the firm's total assets scaled by the firm's lagged bond debt (*Sources: Capital IQ, Compustat*)
Cash	The firm's cash and short-term investments scaled by the firm's lagged bond debt (*Sources: Capital IQ, Compustat*)
Cash growth	Quarterly change in the firm's cash and short-term investments scaled by the firm's lagged bond debt (*Sources: Capital IQ, Compustat*)
Sales	The firm's sales scaled by the firm's lagged bond debt (*Sources: Capital IQ, Compustat*)
Cash flow	The firm's sales net of the cost of goods sold and selling, general, and administrative expenses scaled by the firm's lagged bond debt (*Sources: Capital IQ, Compustat*)
Deferred taxes	The firm's deferred income tax expense scaled by the firm's lagged bond debt (*Sources: Capital IQ, Compustat*)
Tangibility	The firm's net property, plant and equipment scaled by the firm's lagged bond debt (*Sources: Capital IQ, Compustat*)
Market-to-book	Ratio of the book value of the firm's total assets less the book value of equity plus the market value of equity to the the firm's book value of assets (*Source: Compustat*)
Leverage	Ratio of the book value of the firm's total assets to the firm's book value of equity (*Source: Compustat*)
Age	Number of years that the firm has been in Compustat (*Source: Compustat*)

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Table IA.9 – *Continued from previous page*

Variable	**Definition**
Stock return	The firm's 1-year stock return lagged by one month (*Source: CRSP*)
SA index	Hadlock and Pierce (2010)'s index for the firm's financial constraints, defined as $-0.737\min\{4.5\times10^3, size\}+0.043\min\{4.5\times10^3, size\}^2-0.04\min\{37, age\}$, where *size* is the log of inflation-adjusted (to 2004) book assets and *age* the number of years that the firm has been in Compustat (*Sources: Compustat, FRED*)
Z-score	Modified Altman's z-score, defined by Graham and Leary (2011) as $(3.3\times$operating income$+$sales$+1.4\times$retained earnings$+1.2\times$(current assets $-$ current liabilities))/book assets (*Source: Compustat*)
Dividend payer	Indicator variable that equals one if the firm ever paid positive dividends in the past four quarters (*Source: Compustat*)
Earnings volatility	Standard deviation of the trailing 12 quarters of the ratio of the firm's cash flow to lagged total assets (*Source: Compustat*)
Credit rating	The firm's current end-of-quarter credit rating for categories AAA-AA, A, BBB, BB, B, CCC, CC-D, and unrated. The minimum rating is used if two ratings are available, and the middle rating is used if three ratings are available (*Source: Mergent FISD*)
Region	U.S. region in which the firm's headquarter is located. Either Northeast (CT, ME, MA, NH, RI, VT) or Mid-Atlantic (DE, DC, MD, NJ, NY, PA) or Southeast (AL, AR, FL, GA, PR, VI) or Southeast (MS, NC, SC, TN, VA, WV) or Midwest (IA, IN, IL, KS, KY, MI MN, MO, ND, NE, OH, SD, WI) or Southwest (CO, LA, NM, OK, TX, UT) or West (AZ, AK, CA, HI, ID MT, NV, OR, WA, WY, AS)
Industry	Industry categories based on 2-digit SIC if not stated otherwise
Insurer type	Type of potential investors. First, for each insurance line of business (accident & health life, deposit type, annuity, pure life, accident & health P&C, home- & farmowners, and private auto insurance) I define a firm-by-quarter-level variable as the lagged share of premiums written in this line of business by a firm's average potential investor. Second, I compute the first three principal components of these variables, and, third, for each of the three principal components I compute an indicator variable for the upper half of its cross-sectional distribution. Finally, insurer type dummies are based on all possible combinations of these indicator variables (*Source: NAIC*)
Insurer location	Location of potential investors. First, for each U.S. region I define a firm-by-quarter-level variable as the lagged share of premiums written in this region by a firm's average potential investor. Second, I compute the first three principal components of these variables, and follow the above methodology to construct insurer location dummies (*Source: NAIC*)

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Table IA.9 – *Continued from previous page*

Variable	**Definition**
Consumption	Consumption per capita by consumption type in potential investors' location. I start with the total consumption by consumption type in the previous calendar year at the state level (types are: motor vehicles and parts, furnishings and durable household equipment, recreational goods and vehicles, other durable goods, food and beverages purchased for off-premises consumption, clothing and footwear, gasoline and other energy goods, other nondurable goods, household consumption expenditures for services, housing and utilities, health care, transportation services, recreation services, food serves and accommodations, financial services and insurance, other services, final consumption expenditures of nonprofit institutions serving households). First, I define a firm-by-quarter-level variable for each consumption type that reflects the average consumption per capita across states weighted by total insurance premiums written by potential investors. Second, I compute the first three principal components of these variables and follow the above methodology to construct consumption dummies (*Sources: BEA Table SAEXP1, U.S. Census, NAIC*)
Employment	Employment per capita in the firm's industry in potential investors' location. I start with the number of employees by industry in the previous calendar year at the state level. I define a firm-by-quarter-level variable as the average employment per capita in the firm's industry across states weighted by total insurance premiums written by potential investors. Employment dummies are based on the cross-sectional quintiles of this variable (*Sources: BEA Table CAEMP25N, U.S. Census, NAIC*)
Social connectedness	Average social connectedness index between the firm's and its potential investors' locations (at the state level) weighted by potential investors' total insurance premiums. Social connectedness dummies are based on the cross-sectional quartiles of this variable (*Sources:* `https://dataforgood.fb.com/`, *NAIC*)
Issuance level: primary market	
Yield spread	Average difference between offering yield and the contemporaneous yield on its nearest-maturity treasury bond across all bond issues for the same firm-quarter weighted by offering amount (*Source: Mergent FISD, FRED*)
Offering amount	Total offering amount at the firm-by-quarter level (*Source: Mergent FISD*)
Rating	Current end-of-quarter rating with categories AAA-AA, A, BBB, BB, B, CCC, CC-D, and unrated. The minimum rating is used if two ratings are available, and the middle rating is used if three ratings are available (*Source: Mergent FISD*)
Maturity	Based on dummies for the time to maturity at issuance according to the following bins: (0,5], (5,10], (10,15], (15,∞) (*Source: Mergent FISD*)

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Table IA.9 – *Continued from previous page*

Variable	Definition
Bond level: secondary market	
Bond return	Relative change in end-of-quarter prices and accrued interest plus coupon payments, (ΔPrice$_t$ + ΔAccrued Interest$_t$ + Coupon payments$_t$)/(Price$_{t-1}$ + Accrued Interest$_{t-1}$) (*Source: TRACE, Mergent FISD*)
Transaction volume	Total par value of bond transactions in the current quarter (*Source: TRACE*)
Rating	Current end-of-quarter rating with categories AAA-AA, A, BBB, BB, B, CCC, CC-D, and unrated. The minimum rating is used if two ratings are available and the middle rating is used if three ratings are available (*Source: Mergent FISD*)
ΔRating	Change in rating (in notches) between current and previous quarter (*Source: Mergent FISD*)
Maturity	Based on dummies for the remaining time to maturity at the transaction date according to the following bins: (0,5], (5,10], (10,15], (15,∞). (*Source: Mergent FISD*)

A.1 Insurance premiums

Schedule T of U.S. insurers' statutory filings reports the total amount of direct premiums written (excluding reinsurance ceded or assumed) for each U.S. insurer and quarter separately for each U.S. state and territory and Canada. To detect reporting errors, I compare total premiums at the insurer level (across locations) from Schedule T with the total premiums reported in the overview schedule of the same filing. I exclude insurer-quarter observations if the discrepancy between Schedule T and the overview schedule is larger than \$50 thousand and 50% of the average of the two reported total premiums. To cross-check the reliability of my sample of insurance premiums, I compare industry-wide premiums and their geographical distribution with official reports from the NAIC.[31]

To exclude commercial insurance business, I use the share of direct premiums written for noncommercial insurance at the insurer-quarter level (since it is not available at the insurer-state-quarter level). I define the share of noncommercial life insurance as the sum of direct premiums written covering individual life insurance (which provides financial benefits

[31] The NAIC annually publishes aggregate balance sheets and cash flows of the U.S. insurance industry in the *Statistical Compilation of Annual Statement Information for Life/Health Insurance Companies* and *Statistical Compilation of Annual Statement Information for Property/Casualty Insurance Companies.*

to a beneficiary upon the death of the insured), individual annuities (which guarantee a stream of annuity payments), individual accident and health contracts, and deposit-type contracts (which do not expose the insurer to any mortality or morbidity risk) relative to all premiums.[32] These are reported on Exhibit 1 of life insurers' statutory filings. The measure excludes contracts that cover a group of individuals (e.g., the employees of a company or members of an organization), namely, group life insurance, group annuities, group accident and health insurance, and credit life insurance (for which a breakdown into individual and group contracts is not available).

I follow S&P Global Market Intelligence's classification in defining the share of noncommercial P&C insurance as the sum of direct premiums written for farmowners' and homeowners' multiple peril insurance (which provides property and liability coverage for homes and farms) and private auto physical damage and liability insurance (which provides protection against damages and liability to injuries and damages arising from car accidents) relative to all premiums. These are reported on the underwriting and investment exhibit of P&C insurers' statutory filings. The measure excludes P&C contracts used by firms, e.g., product liability, fidelity, or workers' compensation insurance contracts.

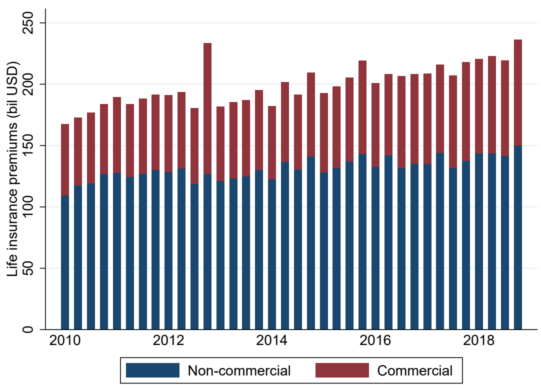
Figures IA.2 and IA.3 illustrate the aggregate dynamics of life and P&C insurance premiums by line of business. Following the above definition, noncommercial insurance is the dominant line of business for both types of insurers. The distribution of noncommercial premiums across more granular lines of business is very stable over time, suggesting no disruptive shifts in the insurance business. Premiums, particularly in P&C insurance, display some seasonality within years, which I account for by including firm-calendar quarter time fixed effects in the main regressions.

Insurers that focus on commercial insurance business are excluded from the sample; I define these as insurers with noncommercial premiums below $50,000 or below 10% of total premiums in the median quarter from 2009q4 to 2018q4. For the remaining insurers, I winsorize premiums at the insurer-state-quarter level at 1%/99%. I measure the total noncommercial premiums written by insurer i in quarter t in locations other than firm f's

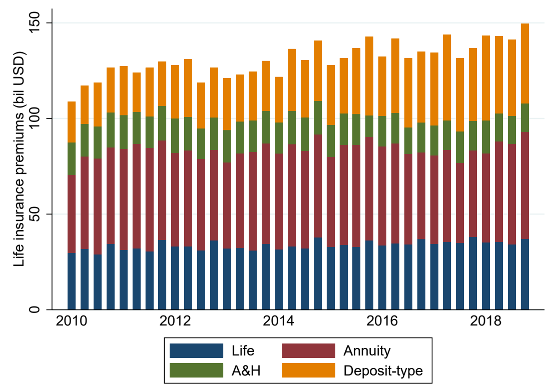
[32] Definitions of insurers' lines of business come from S&P Global Market Intelligence, `https://content.naic.org/consumer_glossary`, `https://www.acli.com/industry-facts/glossary`, and the NAIC Statutory Issue Paper No. 50.

Figure IA.2. Life insurance premiums.

Figure (a) depicts the total life insurance premiums written by the U.S. insurance industry by quarter and type. Noncommercial premiums are for individual life insurance, individual annuities, individual accident and health contracts, and deposit-type contracts. Commercial premiums are the residuals of the total premiums written. Figure (b) depicts the total noncommercial life insurance premiums written by insurers in the sample by quarter and line of business.



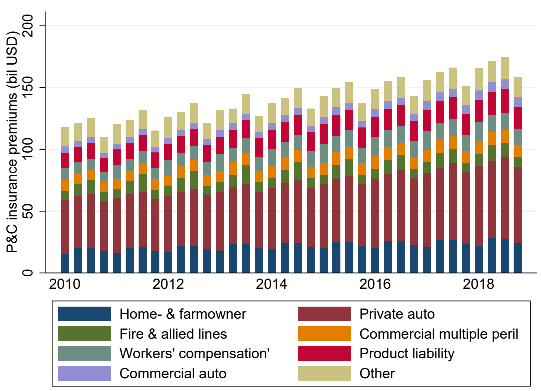
(a) All U.S. insurers.



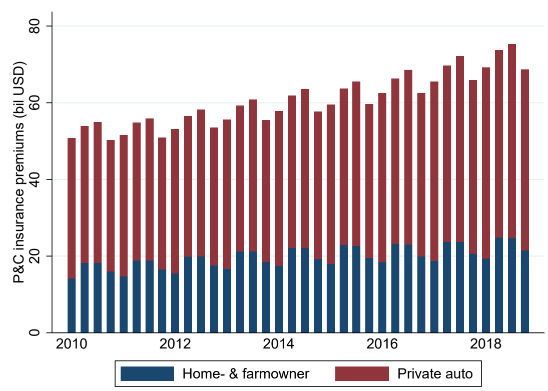
(b) Insurers included in the sample.

Figure IA.3. P&C insurance premiums.

Figure (a) depicts the total P&C insurance premiums written by the U.S. insurance industry by quarter and type. Other lines of business include accident and health, financial and mortgage guarantees, medical professional liability, aircraft, fidelity, surety, and marine insurance. Figure (b) depicts the total noncommercial P&C insurance premiums written by insurers in the sample by quarter and line of business.



(a) All U.S. insurers.



(b) Insurers included in the sample.

location by treating all direct premiums written at the firm's location as noncommercial,

$$\text{Premiums}_{i,f,t} = \max\left\{\sum_{s} \text{noncommercial}_{i,t} \times \text{DPW}_{i,s,t} - \text{DPW}_{i,\text{location}(f),t},\ 0\right\}, \qquad \text{(IA.9)}$$

where $DPW_{i,s,t}$ are direct premiums written by insurer i in location s in quarter t and $\text{noncommercial}_{i,t}$ is the share of noncommercial premiums written (as defined above). By assuming that all premiums in the firm's location are noncommercial, the measure is a conservative estimate for the *actual* noncommercial premiums written in locations other than firm f's location (which is not observable since $\text{noncommercial}_{i,t}$ is available only at the insurer-quarter level).

A.2 Corporate bond holdings and transactions

I identify securities on insurers' Schedule D filings as corporate bonds if they are categorized as such by either insurers or Mergent FISD (matched by 9-digit CUSIP).

To merge bonds with firm characteristics, I begin with the link table provided by Capital IQ, which matches security identifiers reported by insurers (CUSIP and ISIN) to the Capital IQ firm-level identifier *companyid*. I supplement the sample by matching (1) the leading six digits of the CUSIP (the 6-digit issuer CUSIP) reported by insurers with the same identifier in Compustat and (2) the TRACE issuer ticker (merged to insurer filings by 9-digit CUSIP) to the firm ticker in Compustat, deriving the *companyid* using the Capital IQ-Compustat link table. Additionally, I copy missing *companyid*s from observations with the same 6-digit CUSIP. Finally, I match bonds to Mergent FISD and copy missing *companyid*s from observations with the same issuer or parent identifier in FISD. To ensure that bond issuers are correctly identified, for a random subsample I manually compare the company names reported by insurers to those in Capital IQ. Finally, I merge the insurer filings-Capital IQ-matched sample to Compustat using the Capital IQ-Compustat link table.

A.3 Matching insurers' counterparties to underwriters

I match the counterparties reported by insurers for corporate bond purchases to agents in FISD Mergent. First, I manually consolidate agents reported in FISD Mergent's "Agents"

Table IA.10. Matching corporate bond investments to Capital IQ and Compustat.
The table depicts the number of observations for all insurer-security-quarter-level corporate bond holdings (and the total par value across insurers and quarters in parentheses) from Schedule D filings and the share matched to Capital IQ and Compustat. "Matched by: Capital IQ link" uses the Capital IQ link table. "Matching by: Ticker (TRACE & Compustat)" indicates observations first matched to TRACE by CUSIP, second to Compustat by using the ticker, and third to Capital IQ by using the Capital IQ-Compustat link table. "Matched by: 6-digit CUSIP (Compustat)" indicates observations first matched to Compustat by using the 6-digit CUSIP and second to Capital IQ by using the Capital IQ link table. "Copied from: same issuer ID (Mergent)" indicates observations whose Capital IQ identifier is copied from other observations with the same Mergent FISD issuer ID. "Copied from: same 6-digit CUSIP" indicates observations whose Capital IQ identifier is copied from other observations with the same 6-digit CUSIP.

Holdings: Capital IQ match	
Nr. of observations (par value)	16,125,416 ($ 68,107 bil)
% matched by: Capital IQ link	86.84% (79.74%)
% matched by: Ticker (TRACE & Compustat)	0.01% (0.01%)
% matched by: 6-digit CUSIP (Compustat)	0.90% (2.04%)
% copied from: same issuer ID (Mergent)	0.02% (0.03%)
% copied from: same 6-digit CUSIP	0.51% (1.19%)
% matched (par value)	88.28% (83.02%)
Total matched (par value)	14,235,883 ($ 56,540 bil)
Holdings: Compustat match	
% matched (par value)	58.36% (51.56%)
Total matched (par value)	9,410,232 ($ 35,115 bil)

table to the group level by using information on company structure from S&P Global Market Intelligence, `https://brokercheck.finra.org/`, and company resources. There are 93 agents used by firms in my sample. The top five underwriters (by total offering amount in an average year from 2010 to 2018) are Merrill Lynch/Bank of America, Citigroup, JP Morgan, Goldman Sachs, and Mitsubishi UFJ Securities.

Second, because there is no common identifier for agents, I match the consolidated agents from FISD with counterparties reported by insurers by using a combination of fuzzy string merging and manual matching. I manually ensure the quality of the final match by comparing agents' names in FISD and as reported by insurers. There are more than 200 matched counterparties in the sample. The top five counterparties used by insurers in my sample (by total par value purchased in an average year from 2010 to 2018) are Citigroup, JP Morgan, Merrill Lynch/Bank of America, Goldman Sachs, and Barclays.

Figure IA.4. Share of matched insurers' corporate bond holdings.

The figure depicts the cross-sectional distribution of the share of insurers' corporate bond holdings matched to Capital IQ and Compustat over time at the insurer-quarter level. The figure includes only insurers in the baseline sample.

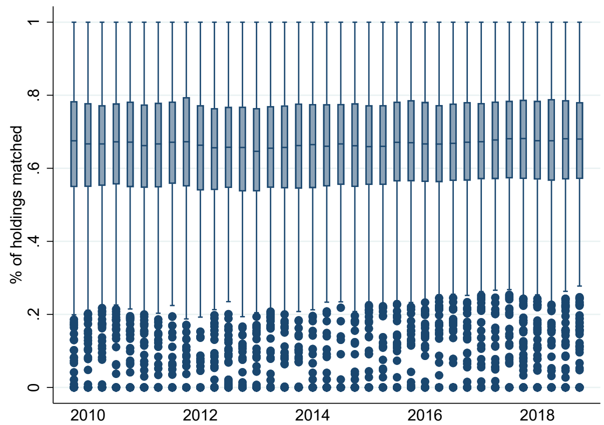


Table IA.11. Matching corporate bond purchases to Mergent FISD agents.

The table depicts the (share of the) number (and, in parentheses, of the total par value) of corporate bond purchases whose counterparty is missing and whose counterparty is matched to Mergent FISD.

Purchases: Counterparty match	
% missing counterparty (par value)	19.5% (33.5%)
% matched (par value)	68.4% (57.1%)
Total matched (par value)	1,129,430 ($ 2,815 bil)

A.4 Classifying primary and secondary market bond purchases

I use three criteria to identify secondary market trades. (1) I match NAIC purchases to TRACE secondary market transactions at the CUSIP level. I flag purchases as secondary market trades if they are matched to a TRACE secondary market transaction (with flag "S1") reported for the same or previous day with a transaction volume and total price paid that differ by not more than $5,000 and with a price difference smaller than 5%. Additionally, (2) purchases made at least 3 days after a bond's offering date and (3) purchases made after the offering date that involve the payment of accrued interest are flagged as secondary market trades.

Purchases are flagged as primary market trades if they are at the offering price, do not involve the payment of accrued interest, and occur within less than 3 days around the offering date.[33] With this classification, I make sure to capture all primary market trades. As a result, the measure plausibly tends to overclassify primary market trades.[34] If the above methodology categorizes a bond purchase as both a primary and a secondary market trade, I flag it as unclassified.

Several observations support the classification strategy:

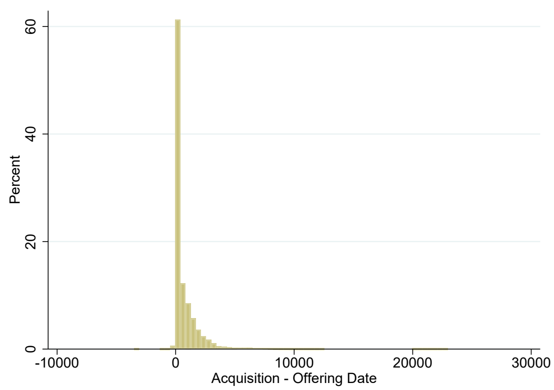
- Less than 1% of all purchases fit into both the primary and secondary market categories.
- Figures IA.5 (a) and (b) show that a large mass of purchases involve zero accrued interest and take place on the offering date. This supports the use of these indicators to identify primary market dates.
- Figure IA.5 (c) shows a large mass of purchases for small price differences between insurer purchases and TRACE transactions after matching to the NAIC transaction for the same CUSIP on the same or previous day with the smallest price difference.

[33]The results are unaffected by using a larger time window to identify primary market trades.

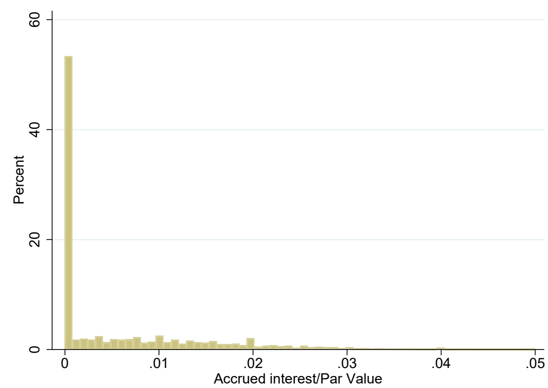
[34]Indeed, previous studies usually rely on a narrower classification. For example, Nikolova et al. (2020) define bond purchases as primary market trades only if they occur on the offering date and are from a bond issue's underwriter.

Figure IA.5. Corporate bond purchases and issue characteristics.

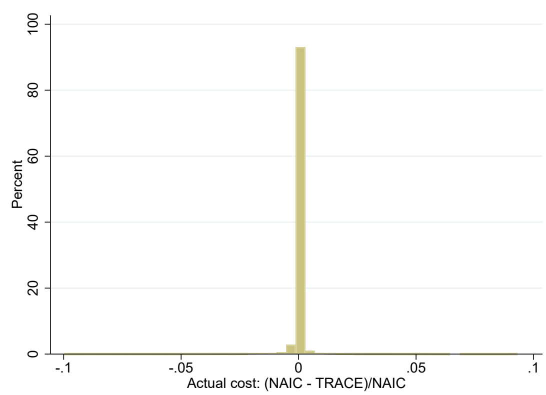
Figure (a) illustrates the distribution of the time (in days) between the offering and purchase dates at the transaction level. Figure (b) illustrates the distribution of accrued interest paid scaled by par value at the transaction level. Figure (c) illustrates the distribution of the relative difference between TRACE and NAIC cost of purchase for all NAIC acquisitions matched to the NAIC transaction for the same CUSIP on the same or previous day with the smallest price difference.



(a) Time lag between aquisition and offering date.



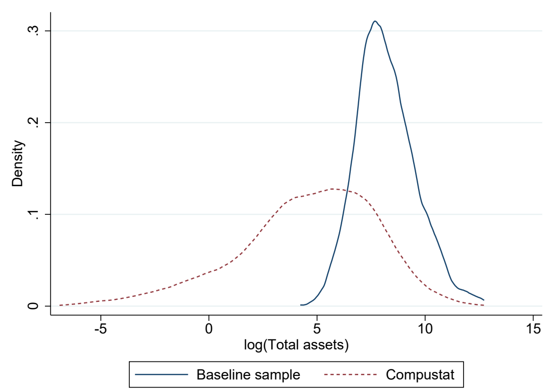
(b) Accrued interest.



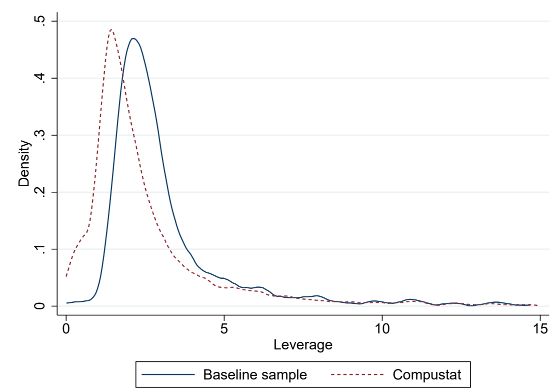
(c) Relative difference between TRACE and NAIC bond price.

A.5 Comparison with Compustat firms

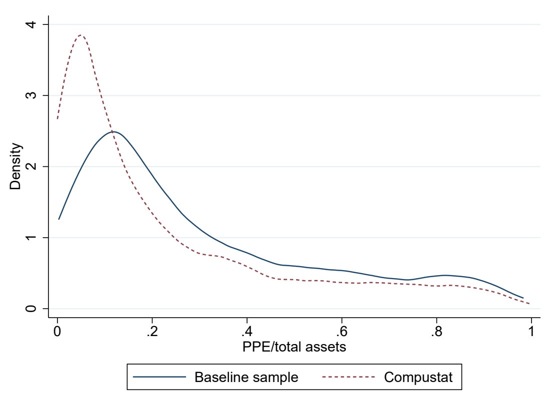
Figure IA.6. Comparison of firm characteristics with nonfinancial firms in Compustat.
The figures depict kernel densities for the cross-sectional distribution of average firm characteristics (from 2010q2 to 2018q4) for firms in my sample compared to all nonfinancial firms in Compustat (excluding financial firms with SIC 6000-6999, utilities with SIC 4900-4999, and firms in public administration with SIC above 8999).



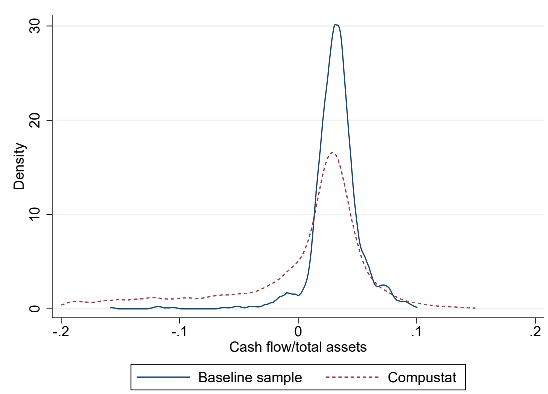
(a) Size.



(b) Leverage.



(c) PPE.



(d) Cash flow.

B Instrument derivation and validity

B.1 Insurers' balance sheet and insurance premiums

This section provides a stylized model of an insurer's balance sheet to illustrate the relationship between asset and premium dynamics.

Consider an insurer that sells one-period insurance contracts to a unit mass of policyholders indexed by $j \in [0, 1]$ in a competitive insurance market.[35] Payments for insured losses $L_{t,j}$ for contract j are made by the insurer to policyholders at t. The actuarially fair premium is $P_{t-1,j} = \mathbb{E}[L_{t,j}]$ to be paid to the insurer at $t-1$ (without loss of generality, the discount rate is set to zero). The insurer's total assets evolve according to

$$\Delta A_t = A_t - A_{t-1} = \int_0^1 P_{t,j} - L_{t,j} \; dj + R_t, \tag{IA.10}$$

where R_t is the net cash flow from other business activities (including investments and shareholder payouts). Assuming that losses are identically and independently distributed across policyholders, total premium income is given by $P_{t-1} = P_{t-1,0} = \int_0^1 P_{t,j} \; dj$ and total loss payments satisfy $L_t = \int_0^1 L_{t,j} \; dj = \mathbb{E}[L_{t,0}] = P_{t-1}$, which implies that

$$\Delta A_t = P_t - P_{t-1} + R_t = \Delta P_t + R_t. \tag{IA.11}$$

Therefore, $\frac{\partial \Delta A_t}{\partial \Delta P_t} = 1 + \frac{\partial R_t}{\partial \Delta P_t}$, i.e., premium growth passes through to asset growth but is potentially compensated by other activities (i.e., if $\frac{\partial R_t}{\partial \Delta P_t} < 0$). Consistent with this relationship, the empirical results show that premium increases pass through to insurers' total asset growth, while premium decreases are compensated by adjustments to insurers' funding sources, raising R_t.

As an implication, the volume of insurance premiums is an important determinant of insurer size (with insurer origination at $t = 0$),

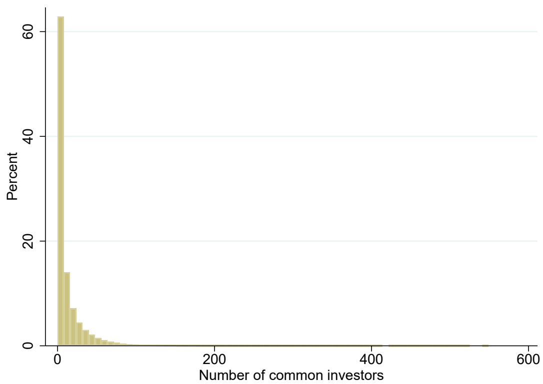
$$A_t = A_0 + \sum_{\tau=1}^{t} \Delta A_\tau = P_0 + R_0 + \sum_{\tau=1}^{t} (\Delta P_\tau + R_\tau) = P_t + \sum_{\tau=0}^{t} R_\tau. \tag{IA.12}$$

[35] Insights remain qualitatively unchanged when allowing for imperfect competition.

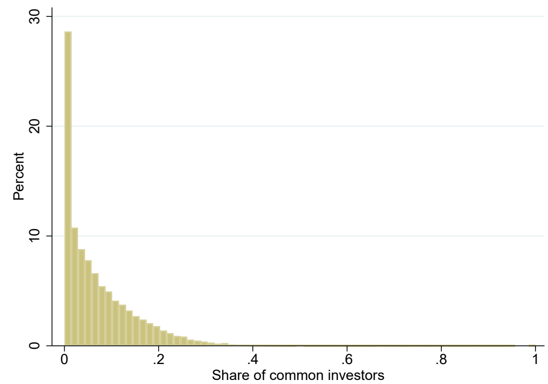
B.2 Insurers' investment preferences

Figure IA.7. Distribution of common bond owners.

The figures show the pooled distribution of (a) a firm pair's number of common investors (i.e., insurers holding both firms' bonds) and (b) its share relative to a firm pair's total number of investors across firm pair-by-quarter observations.



(a) Number of common investors.



(b) Share of common investors.

Figure IA.8. Diversification of insurers' bond portfolios across issuers.

The figure relates the number of bond issuers in an insurer's portfolio to the insurer's size, measured by total assets. The binscatter plot is based on the means in 50 bins of total assets, pooled across insurer-by-quarter observations, and also includes the line of best fit from an OLS regression.

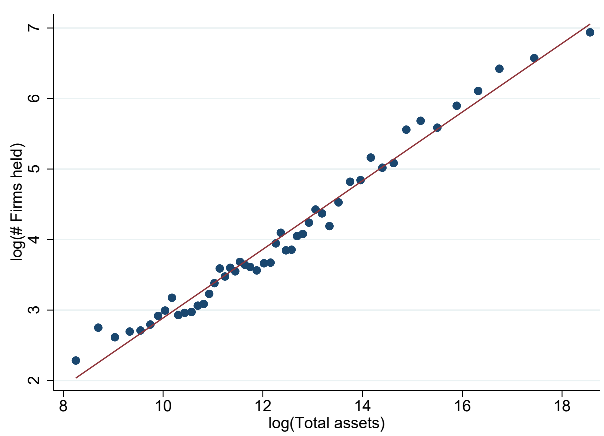
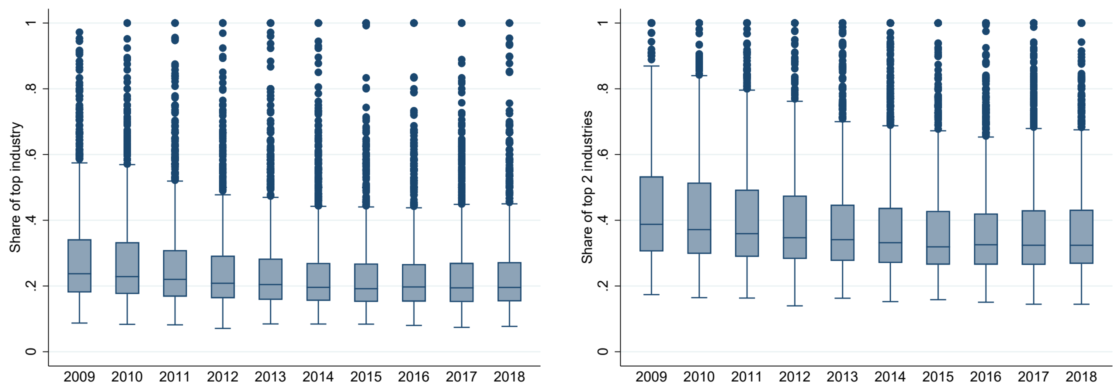


Figure IA.9. Concentration of bond holdings across issuer industries.

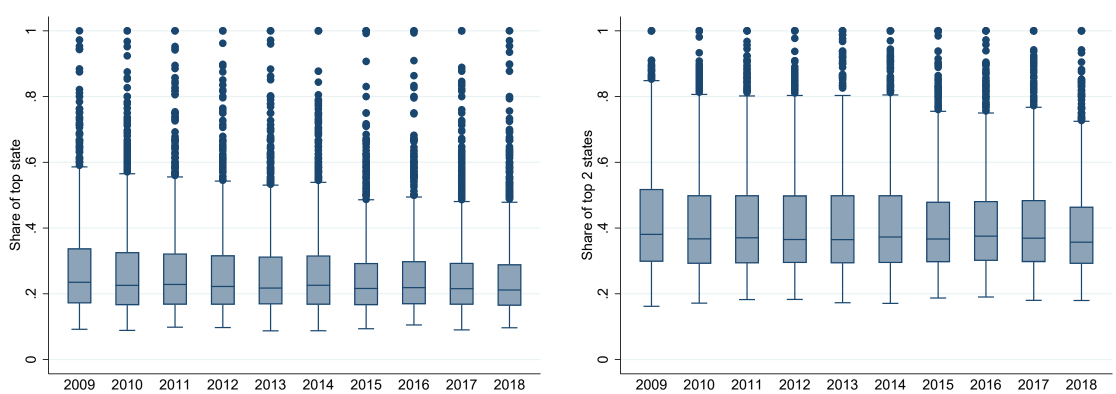
The figures show box plots of the share of insurers' corporate bond holdings in the top (a) 1 and (b) 2 industries (at the 2-digit SIC level) among all industry-matched corporate bond holdings at the insurer level based on end-of-year holdings.



(a) Top 1 industry. (b) Top 2 industries.

Figure IA.10. Concentration of bond holdings across firms' locations.

The figures show box plots of the share of insurers' corporate bond holdings from bond issuers located in the top (a) 1 and (b) 2 U.S. states among all issuer state-matched corporate bond holdings at the insurer level based on end-of-year holdings.



(a) Top 1 state. (b) Top 2 states.

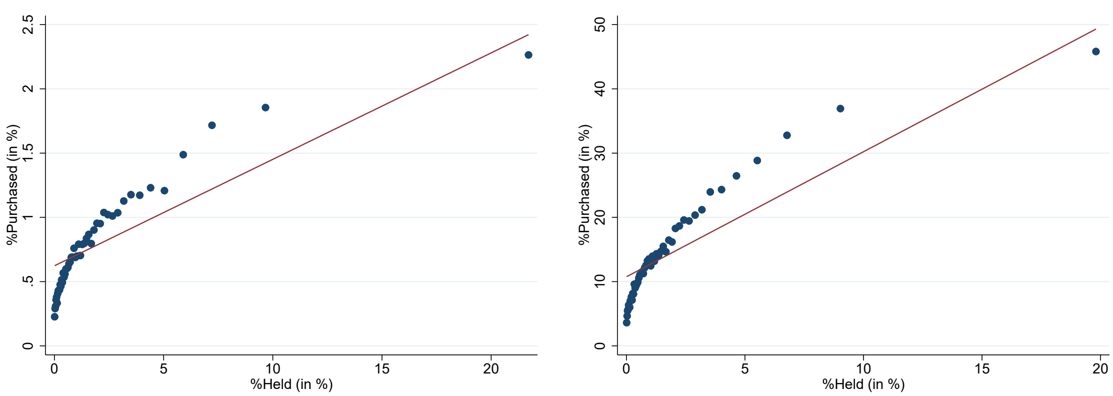
Table IA.12. Persistence of the set of firms invested in.

The table reports the percentage of corporate bond issuers in the current year's portfolio that were ever held in the previous one to 10 quarters. Each cell is a pooled median value across insurers in the same portfolio size decile and across quarters from 2009q4 to 2018q4. Corporate bond portfolio size deciles are based on the distribution of the total corporate bond portfolio's par value across insurers in 2009q4.

Bond portfolio size decile	Previous quarters									
	1	2	3	4	5	6	7	8	9	10
1	92.8%	92.9%	92.9%	93.1%	93.1%	93.1%	93.1%	93.1%	93.2%	93.2%
2	93.6%	93.6%	93.7%	93.8%	93.8%	93.9%	93.9%	93.9%	93.9%	94.0%
3	92.9%	93.1%	93.2%	93.3%	93.4%	93.4%	93.5%	93.5%	93.5%	93.6%
4	93.1%	93.2%	93.2%	93.4%	93.4%	93.5%	93.5%	93.5%	93.6%	93.6%
5	93.5%	93.6%	93.7%	93.8%	93.8%	93.9%	93.9%	93.9%	94.0%	94.0%
6	93.4%	93.6%	93.7%	93.8%	93.9%	93.9%	94.0%	94.0%	94.0%	94.1%
7	93.6%	93.7%	93.9%	94.1%	94.2%	94.2%	94.3%	94.3%	94.3%	94.4%
8	94.8%	94.9%	95.0%	95.1%	95.2%	95.3%	95.4%	95.4%	95.4%	95.5%
9	95.3%	95.5%	95.6%	95.8%	95.8%	95.9%	95.9%	96.0%	96.0%	96.0%
10	96.3%	96.4%	96.6%	96.7%	96.8%	96.8%	96.9%	96.9%	96.9%	97.0%

Figure IA.11. Portfolio and purchase shares.

The figures relate the share of a firm's bonds among an insurer's total bond purchases, $\%\text{Purchased}_{i,f,t} = 100 \times \frac{\text{Bond purchases}_{i,f,t}}{\sum_g \text{Bond purchases}_{i,g,t}}$, to that among total bond holdings, $\%\text{Held}_{i,f,t} = 100 \times \sum_{\tau=1}^{4} \frac{\text{Bond holdings}_{i,f,t-\tau}}{4 \times \sum_g \text{Bond holdings}_{i,g,t-\tau}}$ averaged across the lagged 4 quarters. The binscatter plots are based on the means in 50 bins of $\%\text{Held}_{i,f,t}$, pooled across insurer-by-firm-by-quarter observations with nonzero holdings, $\%\text{Held}_{i,f,t} > 0$, and (a) nonzero total bond purchases, $\sum_g \text{Bond purchases}_{i,g,t} > 0$, and (b) nonzero purchases of the firm's bonds, $\text{Bond purchases}_{i,f,t} > 0$. Each panel also includes the line of best fit from an OLS regression.



(a) Extensive and intensive margin of purchases.

(b) Intensive margin of purchases.

Table IA.13. Variance decomposition of insurers' investment preferences.

The table reports the variation explained by firm, insurer, and time fixed effects (R^2) in insurers' investment universe implied by $\mathbb{I}(\text{Investor}_{i,f,t-(1:8)})$. $\mathbb{I}(\text{Investor}_{i,f,t-(1:8)})$ is equal to one if insurer i ever held firm f's bonds in the previous 8 quarters and zero otherwise. The sample includes all possible insurer-firm pairs of firms and insurers included in the baseline sample at time t.

Fixed Effects:	None	Firm & Insurer-Time	Firm-Time & Insurer-Time	Insurer-Firm	Insurer-Firm & Firm-Time	Insurer-Firm & Firm-Time & Insurer-Time
SD(Residuals)	0.24	0.21	0.21	0.12	0.12	0.12
R^2		0.22	0.23	0.74	0.75	0.76
Adj. R^2		0.22	0.23	0.73	0.74	0.75

Table IA.14. Persistence of insurers' portfolio allocation: Determinants.
Each column presents OLS estimates from a specification of the form:

$$1\{\text{Purchase}_{i,f,t}\} = \alpha\, \mathbb{I}(\text{Investor}_{i,f,t-(1:8)}) + \Gamma' C_{i,f,t} + \varepsilon_{i,f,t}$$

at the insurer-by-firm-by-quarter level, where $\mathbb{I}(\text{Investor}_{i,f,t-(1:8)})$ equals one if insurer i ever held bonds issued by firm f in the previous 1 to 8 quarters and zero otherwise, and $C_{i,f,t}$ is a vector of fixed effect dummies. Insurer size quintiles in column (1) are indicators based on the cross-sectional distribution of insurers' total assets. Firm age is the firm's current age standardized to mean zero and unit variance. Firm volatility is the idiosyncratic volatility of the firm's equity defined as in Ang et al. (2009) standardized to mean zero and unit variance. log Bond debt is the logarithm of the firm's total bond debt. Firm size bins are based on the quintiles of the cross-sectional distribution of firms' total assets. Firm industry is based on the 2-digit SIC classification. Firm rating bins are: unrated, AA-AAA, A, BBB, BB, B, CCC, D-CC. The *difference in α relative to baseline* is the relative difference between the point estimate for α in this table and that in column (2) of Table 3. t-statistics are shown in brackets and based on standard errors clustered at the insurer and firm levels. ***, **, and * indicate significance at the 1%, 5%, and 10% levels.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variable:				1{Purchase}			
$\mathbb{I}$(Investor) × Insurer size:Quint1	0.00**						
	[2.33]						
$\mathbb{I}$(Investor) × Insurer size:Quint2	0.01***						
	[5.34]						
$\mathbb{I}$(Investor) × Insurer size:Quint3	0.01***						
	[7.19]						
$\mathbb{I}$(Investor) × Insurer size:Quint4	0.02***						
	[11.31]						
$\mathbb{I}$(Investor) × Insurer size:Quint5	0.04***						
	[16.87]						
$\mathbb{I}$(Investor)		0.02***	0.03***	0.02***	0.02***	0.02***	0.02***
		[14.86]	[17.79]	[16.78]	[16.54]	[15.19]	[13.49]
$\mathbb{I}$(Investor) × log(Bond debt)		0.01***					
		[7.23]					
$\mathbb{I}$(Investor) × Firm age		-0.01***					
		[-5.40]					
$\mathbb{I}$(Investor) × Firm volatility		0.01***					
		[3.84]					
Insurer-Time FE	Y	Y	Y	Y	Y	Y	Y
Firm-Time FE	Y	Y	Y	Y	Y	Y	Y
Firm state-Insurer FE			Y				Y
Firm industry-Insurer FE				Y			Y
Firm size-Insurer FE					Y		Y
Firm rating-Insurer FE						Y	Y
No. of obs.	22,070,618	22,070,618	22,070,618	22,070,618	22,070,618	22,070,618	22,070,618
No. of insurers	871	871	871	871	871	871	871
No. of firms	1,480	1,480	1,480	1,480	1,480	1,480	1,480
Relative effect of $\mathbb{I}$(Investor)			13.37	12.31	11.30	11.30	7.71
Difference in α relative to baseline:			-0.05	-0.12	-0.19	-0.19	-0.45

Table IA.15. Local determinants of potential investors.
Each column presents OLS estimates for the effect of a common economic environment on the likelihood of insurer i being a potential investor of firm f,

$$\mathbb{I}(\text{Investor}_{i,f,t-(1:8)}) = \alpha X_{i,f,t} + u_{i,t} + v_{f,t} + \varepsilon_{i,f,t}$$

at the insurer-by-firm-by-quarter level, where $\mathbb{I}(\text{Investor}_{i,f,t-(1:8)})$ equals one if insurer i ever held bonds issued by firm f in the previous 1 to 8 quarters and zero otherwise, $u_{i,t}$ are insurer-by-time fixed effects, and $v_{f,t}$ are firm-by-time fixed effects. Social connectedness is the logarithm of Bailey et al. (2018)'s social connectedness index between firm's and insurance customers' locations. %Employed same industry is the employment per capita in the firm's industry in insurance customers' locations. *Terc* is the cross-sectional tercile of the respective variable. t-statistics are shown in brackets and based on standard errors clustered at the insurer and firm levels. ***, **, and * indicate significance at the 1%, 5%, and 10% levels.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable:	$\mathbb{I}$(Investor)					
1{Same state}	-0.00					
	[-1.45]					
1{Same region}		-0.00				
		[-0.16]				
Social connectedness			-0.00			
			[-0.24]			
Social connectedness: Terc2				-0.00		
				[-0.12]		
Social connectedness: Terc3				-0.00		
				[-0.29]		
%Employed same industry					-0.01	
					[-0.18]	
%Employed same industry: Terc2						-0.00
						[-0.87]
%Employed same industry: Terc3						0.00
						[0.30]
Insurer-Time FE	Y	Y	Y	Y	Y	Y
Firm-Time FE	Y	Y	Y	Y	Y	Y
No. of obs.	22,016,192	22,016,192	22,016,192	22,016,192	22,016,192	22,016,192
No. of insurers	1,445	1,445	1,445	1,445	1,445	1,445
No. of firms	871	871	871	871	871	871
Standardized coefficients						
1{Same state}	-0.00					
1{Same region}		0.00				
Social connectedness			0.00			
Social connectedness: Terc2				0.00		
%Employed same industry					-0.00	
%Employed same industry: Terc2						-0.00

Table IA.16. Investment preferences of different types of insurers.

Each column presents OLS estimates for the effect of insurer and firm characteristics on the likelihood of insurer i being a potential investor of firm f,

$$\mathbb{I}(\text{Investor}_{i,f,t-(1:8)}) = \alpha \, X_{i,f,t} + u_{i,t} + v_{f,t} + \varepsilon_{i,f,t}$$

at the insurer-by-firm-by-quarter level, where $\mathbb{I}(\text{Investor}_{i,f,t-(1:8)})$ equals one if insurer i ever held bonds issued by firm f in the previous 1 to 8 quarters and zero otherwise, $u_{i,t}$ are insurer-by-time fixed effects, and $v_{f,t}$ are firm-by-time fixed effects. 1{Life insurer} is an indicator for life insurers. 1{Investment grade} is an indicator for a firm having an investment grade credit rating (BBB- or better). 1{Unrated} is an indicator for a firm having no credit rating. Time to maturity is the average time to maturity of a firm's outstanding bonds (in years) weighted by offering amount. Insurer size × Firm size is the interaction of a firm's 1-quarter-lagged log total assets and an insurer's 1-quarter-lagged log total assets. t-statistics are shown in brackets and based on standard errors clustered at the insurer and firm levels. ***, **, and * indicate significance at the 1%, 5%, and 10% levels.

	(1)	(2)	(3)	(4)
Dependent variable:		$\mathbb{I}$(Investor)		
1{Life insurer} × Time to maturity	0.02***			
	[7.38]			
1{Life insurer} × 1{Investment grade}		0.11***		
		[13.28]		
1{Life insurer} × 1{Unrated}			-0.07***	
			[-10.67]	
Insurer size × Firm size				0.01***
				[21.86]
Insurer-Time FE	Y	Y	Y	Y
Firm-Time FE	Y	Y	Y	Y
No. of obs.	20,266,745	22,016,192	22,016,192	22,012,755
No. of insurers	1,445	1,445	1,445	1,445
No. of firms	817	871	871	871

B.3 Natural disaster exposure

This section details the construction of the natural disaster-based instrument. I retrieve information about the fatalities from heat and storms from the Spatial Hazard Events and Losses Database for the United States (SHELDUS), which I scale by population size from the U.S. Census. I exclude all P&C insurers from the natural disaster-based instrument. To mitigate the impact of considered disasters on life insurance pricing or payouts, I drop the most extreme disasters with the 5% largest fatalities per capita and winsorize observations at 5/95%, which also ensures that the identifying variation is driven by outliers.

I denote by Disaster fatalities$_{i,t-1}$ life insurer i's exposure to disaster fatalities in quarter $t-1$, defined as the sum across all states s in which i is active of the number of fatalities per 100,000 residents in state s at $t-1$ multiplied by the average share of premiums written by insurer i in state s, namely

$$\text{Disaster fatalities}_{i,t-1} = \sum_{s} 1\{\text{Premiums}_{i,s,t-1} > 0\} \times \text{Fatalities}_{s,t-1} \times \frac{1}{n_i} \sum_{\tau} \frac{\text{Premiums}_{i,s,\tau}}{\sum_h \text{Premiums}_{i,h,\tau}},$$

where n_i is the number of dates with observations for insurer i.

Column (6) in Table 2 shows that increases in Disaster fatalities$_{i,t-1}$ significantly raise insurers' bond purchases, controlling for insurer-specific seasonality, aggregate trends, and insurer characteristics. This effect is driven by insurance premiums, which increase with disaster fatalities at both the insurer-by-state and insurer levels, whereas life insurance payouts do not significantly correlate with disasters (see Appendix Table IA.17).

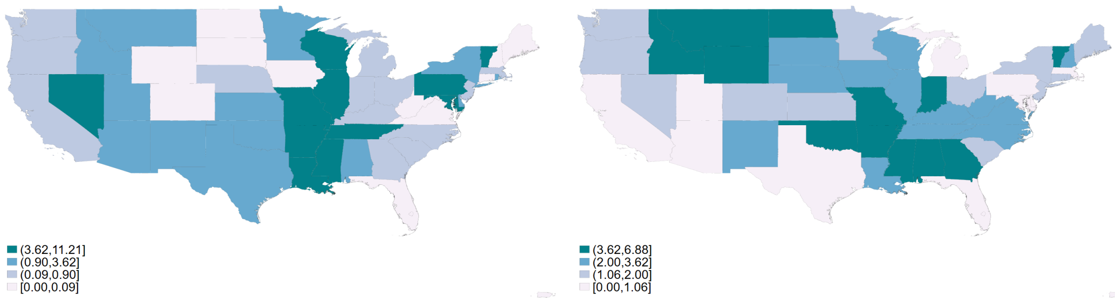
Firms might be subject to the same disasters as insurers, which is a potential concern if sorting of insurers across firms was correlated with common disaster exposure. To tackle this concern, I exclude from Disaster fatalities$_{i,t-1}$ the state in which a firm is located and all of its neighboring states, and denote the resulting variable by Distant disaster fatalities$_{i,f,t-1}$. Aggregating across all life insurers that are potential investors yields

$$\overline{D}_{f,t} = \sum_{\text{Life insurers } i} \mathbb{I}(\text{Investor}_{i,f,t-(1:8)}) \times \text{Distant disaster fatalities}_{i,f,t-1}. \tag{IA.13}$$

I use $\overline{D}_{f,t}$ as a substitute for premiums $\overline{P}_{f,t}$ in Equation (3) to define an alternative instrument denoted $\Delta\text{INVDisasters}^{>0}_{f,t}$,

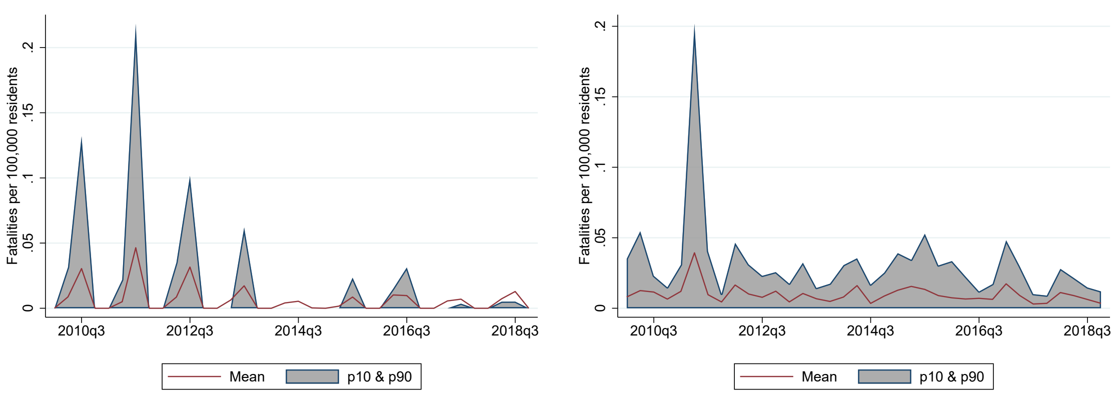
$$\Delta\text{INVDisasters}^{>0}_{f,t} = \max\left\{\Delta \log \bar{D}_{f,t} \times \%\text{Held by insurers}_{f,t-1}, 0\right\}. \qquad \text{(IA.14)}$$

Figure IA.12. Geographic variation in natural disasters.
The figures depict the state-level standard deviation of fatalities per 100,000 residents caused by (a) heat and (b) storms from 2010q1 to 2018q4, multiplied by 100 for readability and winsorized at 1/99%.



(a) Heat. (b) Storms.

Figure IA.13. Time-series variation in natural disasters.
The figures illustrate the cross-sectional distribution of fatalities per 100,000 residents at the state-quarter level caused by (a) heat and (b) storms from 2010q1 to 2018q4, scaled by 100 for readability and winsorized at 1/99%.



(a) Heat. (b) Storms.

Table IA.17. Natural disasters, insurance premiums, and insurers' balance sheet.
Column (1) presents estimated coefficients from specifications of the form:

$$\log(\text{Premiums}_{i,s,t}) = \alpha \text{ Disaster fatalities}_{i,s,t-1} + u_{i,t} + v_{i,s,\text{quarter}(t)} + \varepsilon_{i,s,t}$$

at the insurer-by-state-by-quarter level, where $u_{i,t}$ are insurer-by-time fixed effects and $v_{i,s,\text{quarter}(t)}$ are insurer-by-state-by-calendar quarter (seasonality) fixed effects, the use of which necessitates the exclusion of several insurers active in only one state. $\log(\text{Premiums}_{i,s,t})$ are noncommercial life insurance premiums written by insurer i in state s at t. Disaster fatalities$_{i,s,t-1}$ are the total fatalities per 100,000 residents caused by heat and storms in state s at time $t-1$ weighted by the average share of premiums written by insurer i in state s. Columns (2) to (6) present estimated coefficients from specifications of the form:

$$Y_{i,t} = \alpha \text{ Disaster fatalities}_{i,t-1} + u_{i,\text{quarter}(t)} + v_t + \varepsilon_{i,t}$$

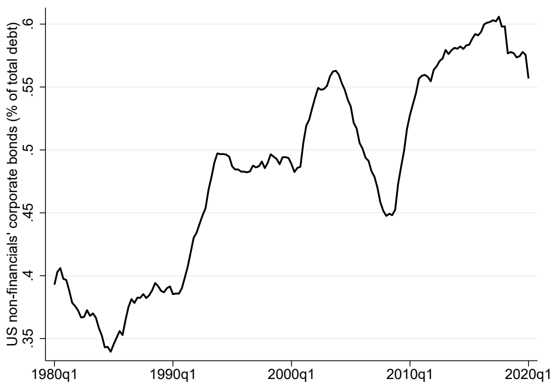
at the insurer-by-quarter level, where $u_{i,\text{quarter}(t)}$ are insurer-by-calendar quarter (seasonality) fixed effects and v_t are time fixed effects. Disaster fatalities$_{i,t-1}$ is the sum of Disaster fatalities$_{i,s,t-1}$ across states. Insurer controls are an insurer's investment yield, life insurance profitability, fee income, rating dummies, and lagged return on equity. t-statistics are shown in brackets and based on standard errors clustered at the insurer and state levels in column (1) and at the insurer and region-by-time levels in columns (2) to (6). The sample includes only life insurers. ***, **, and * indicate significance at the 1%, 5%, and 10% levels.

	(1)	(2)	(3)	(4)	(5)	(6)
Level:	Insurer-State	Insurer				
Dependent variable:	log(Premiums)			log(Benefits)	$\frac{\text{Bond purchases}}{\text{Total assets}_{t-1}}$	
Disaster fatalities	3.61***	1.18***	1.16***	0.11		
	[4.35]	[3.13]	[3.11]	[0.36]		
ΔDisaster fatalities$^{>0}$					0.07***	0.07***
					[3.11]	[2.88]
Insurer controls			Y			Y
Insurer FE		Y	Y	Y	Y	
Insurer-Time FE	Y					
Insurer-State-Seasonality FE	Y					
Insurer-Seasonality FE						Y
Time FE		Y	Y	Y	Y	Y
No. of obs.	598,627	15,923	15,923	15,381	15,923	15,923
No. of insurers	451	505	505	499	505	505

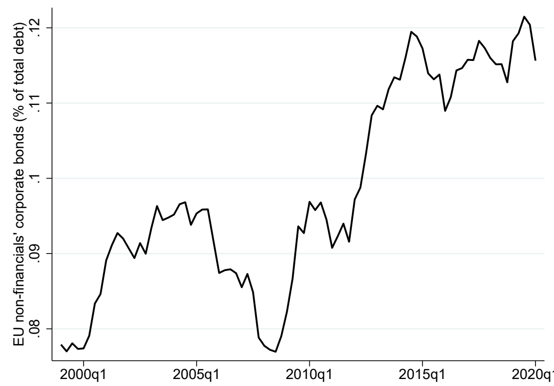
C Additional figures

Figure IA.14. Bond debt share.

The figures depict the volume of nonfinancial firms' corporate bond debt relative to their total debt. Total debt is measured as the sum of debt securities and loans. (a) Data are retrieved from the Z.1 Financial Accounts of the United States, Release Table B.103. (b) Corporate bonds are measured by total debt securities. Data are retrieved from the ECB Statistical Data Warehouse for the EU19.



(a) US.



(b) EU.

Figure IA.15. Corporate bond holdings by investor type.

The figure depicts the share of corporate bond holdings by different investor types in the U.S. after foreign holdings are excluded. Data are from the Z.1 Financial Accounts of the United States, Release Table L.213.

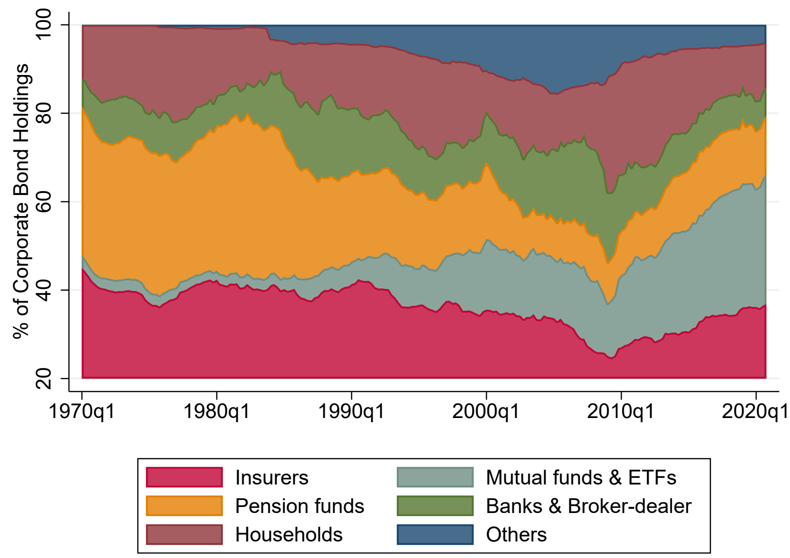
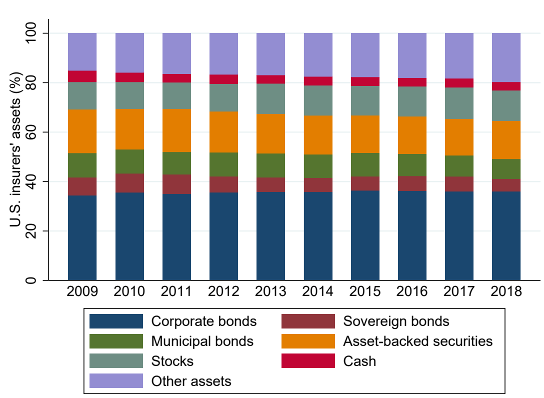
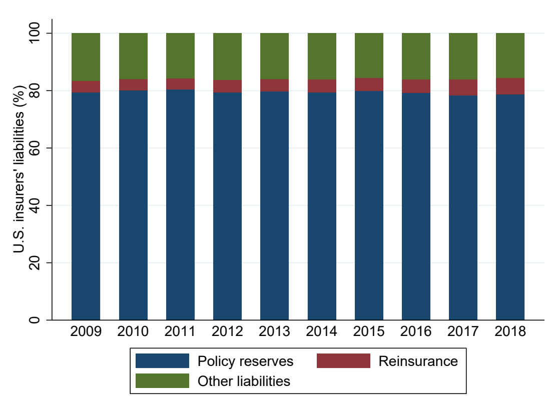


Figure IA.16. Insurers' assets and liabilities.

The figures depict the breakdown of U.S. insurers' aggregate general account assets and liabilities at year-end based on statutory filings. (a) Assets are cash and invested assets. Sovereign bonds include U.S. treasuries and foreign sovereign bonds. Other assets include mortgage loans, real estate, derivatives, and other investments. (b) Policy reserves include contract reserves, interest maintenance reserves, and asset valuation reserves. Other liabilities include borrowings, taxes, payables to parents, subsidiaries, and affiliates, and other liabilities.



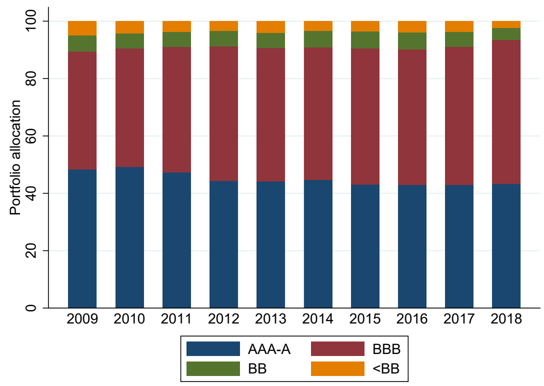
(a) Assets.



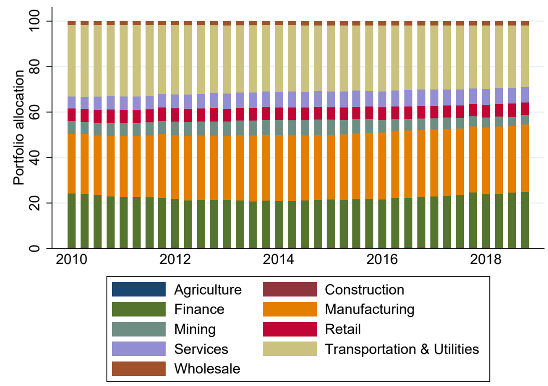
(b) Liabilities.

Figure IA.17. Insurers' corporate bond holdings.

The figures depict the allocation of U.S. insurers' corporate bond holdings (at par value) across (a) credit ratings and (b) industries. Credit rating is determined by insurers' self-reported rating or the current rating in Mergent FISD, whichever is lower. Figure (b) includes only bond holdings matched to Compustat's SIC industry classification.



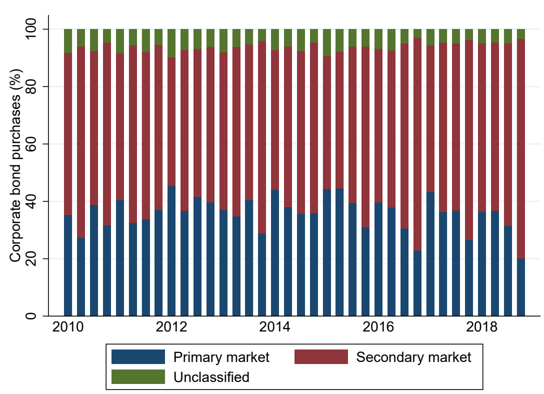
(a) Credit rating.



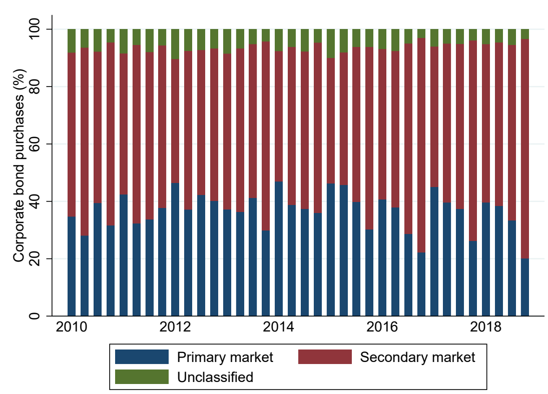
(b) Industry.

Figure IA.18. Insurers' corporate bond purchases by market type.

The figures depict the breakdown of insurers' corporate bond purchases into those in the primary market, secondary market, and unclassified purchases for (a) all insurers and (b) insurers in the baseline sample.



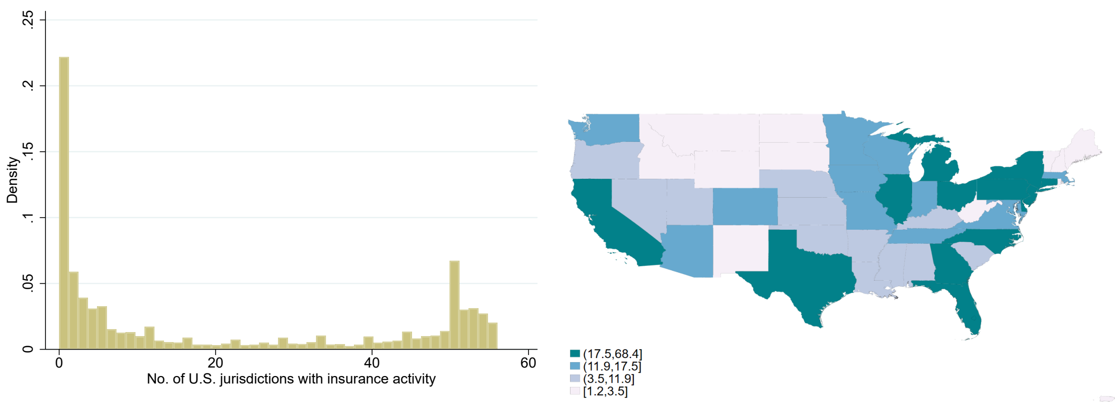
(a) All insurers.



(b) Insurers in the sample.

Figure IA.19. Geographic distribution of insurance premiums.

(a) Histogram of the number of jurisdictions (50 U.S. states, DC, and 5 U.S. territories) in which an insurer writes positive insurance premiums, pooled across insurers and year-quarter observations from 2010q1 to 2018q4 for insurers in the baseline sample. (b) Geographic distribution of annual insurance premiums (in billion USD) written by insurers in the baseline sample in an average year (from 2010 to 2018) across U.S. states.



(a) Number of U.S. states in which an insurer is active in.

(b) Geographic distribution of insurance premiums (billion USD).

Figure IA.20. Insurer-level variation in insurance premiums.

The figure depicts the distribution of the average absolute quarterly change in noncommercial insurance premiums, $\frac{1}{n_t}\sum_t \frac{|\text{Premiums}_{i,t}-\text{Premiums}_{i,t-1}|}{\text{Premiums}_{i,t-1}}$, across insurers.

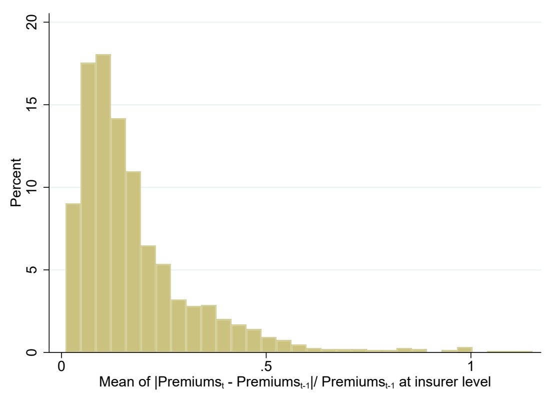
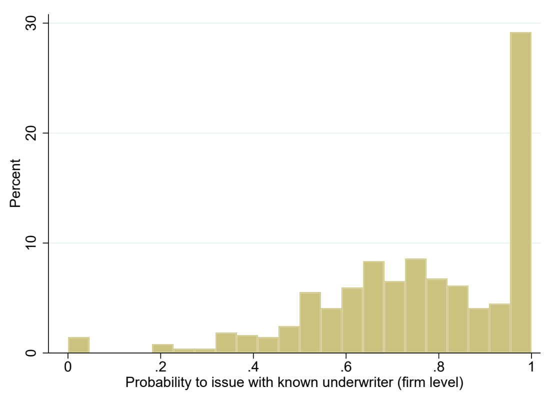
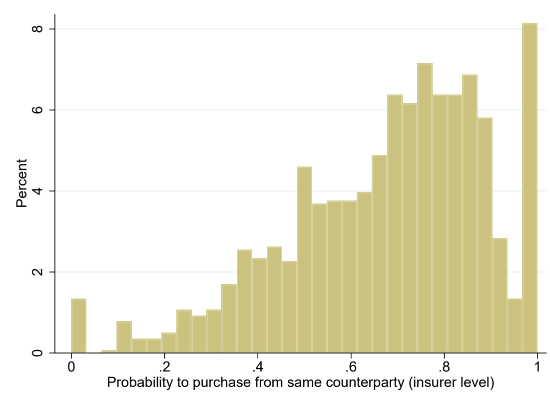


Figure IA.21. Underwriter relationships.

Figure (a) depicts the histogram across firms of the firm-level share of bond issuances involving an underwriter that the firm worked with in the previous 4 quarters. Figure (b) depicts the histogram across insurers of the insurer-level share of purchases (at the quarter level) involving a dealer from which the insurer purchased corporate bonds in the previous 4 quarters.



(a) Firm-underwriter relationship.



(b) Insurer-dealer relationship.

D Additional tables

D.1 Summary statistics

Table IA.18. Summary statistics for additional issuance and bond characteristics.
Summary statistics at quarterly frequency from 2010q2 to 2018q4. All variables are winsorized at the 1/99% levels.

	N	Mean	SD	p5	p50	p95
Issuance level: Primary market						
Time to maturity (yrs)	1,017	10.80	6.22	4.88	10.00	25.02
AA-AAA rating	1,017	0.07	0.25	0.00	0.00	1.00
A rating	1,017	0.22	0.41	0.00	0.00	1.00
BBB rating	1,017	0.37	0.48	0.00	0.00	1.00
High yield	1,017	0.34	0.47	0.00	0.00	1.00
Unrated	1,017	0.00	0.05	0.00	0.00	0.00
Bond level: Secondary market						
Time to maturity (yrs)	29,699	9.32	8.74	1.00	6.12	28.42
AA-AAA rating	29,699	0.10	0.31	0.00	0.00	1.00
A rating	29,699	0.32	0.47	0.00	0.00	1.00
BBB rating	29,699	0.45	0.50	0.00	0.00	1.00
High yield	29,699	0.12	0.33	0.00	0.00	1.00
Unrated	29,699	0.00	0.03	0.00	0.00	0.00
Duration	29,672	6.35	4.50	0.93	5.19	15.59

Table IA.19. Summary statistics for additional insurer and firm characteristics.
Summary statistics at quarterly frequency from 2010q2 to 2018q4. All variables are winsorized at the 1/99% levels.

	N	Mean	SD	p5	p50	p95
Insurer level						
Life insurer	45,231	0.36	0.48	0.00	0.00	1.00
ΔInvestments/Total assets$_{t-1}$ (%)	45,231	0.85	4.55	-5.68	0.68	7.60
Bond purchases (New)/Total assets$_{t-1}$ (%)	32,536	0.78	1.16	0.00	0.39	3.01
Bond purchases (Old)/Total assets$_{t-1}$ (%)	32,536	1.55	2.34	0.00	0.74	5.98
Return on equity	45,231	4.33	20.90	-28.44	4.76	33.23
Investment yield	45,231	3.12	1.57	0.72	2.98	5.71
# Firms held	45,231	160.91	271.99	4.00	61.00	693.00
P&C insurance profitability	29,032	5.38	5.20	-0.58	4.68	15.53
Life insurance profitability	16,199	9.86	33.23	-33.97	4.90	69.71
Life insurance fee income	16,199	1.85	5.03	0.00	0.00	13.15
Firm level: Firm characteristics						
Total assets (bil USD)	15,765	13.22	30.74	0.73	4.35	49.28
log Total assets$_{t-1}$	15,765	8.49	1.29	6.59	8.37	10.79
ΔTotal assets$_{t-1}$/Bond debt$_{t-1}$ (%)	15,765	7.82	38.04	-36.69	2.91	67.66
Sales$_{t-1}$/Bond debt$_{t-1}$ (%)	15,765	148.45	190.87	16.94	85.92	523.85
Cash flow$_{t-1}$/Bond debt$_{t-1}$ (%)	15,765	20.12	23.52	0.95	14.17	58.67
ΔCash$_{t-1}$/Bond debt$_{t-1}$ (%)	15,765	0.36	20.10	-29.85	0.11	30.00
Cash$_{t-1}$/Bond debt$_{t-1}$ (%)	15,765	63.14	86.30	1.69	30.56	240.65
PPE$_{t-1}$/Bond debt$_{t-1}$ (%)	15,765	171.49	188.96	12.91	113.83	528.25
Deferred Taxes$_{t-1}$/Bond debt$_{t-1}$ (%)	15,765	-0.02	3.85	-5.34	0.00	5.22
Market-to-book$_{t-1}$	15,765	1.80	0.94	0.92	1.52	3.81
Leverage$_{t-1}$	15,765	3.69	4.28	1.57	2.53	8.91
Age (yrs)	15,765	29.80	14.98	7.25	27.50	53.50
Stock return (%)	15,765	16.27	38.81	-42.69	13.65	83.18
SA index	15,765	-4.12	0.43	-4.63	-4.17	-3.35
Z-score	15,765	0.81	0.69	-0.34	0.85	1.83
Dividend payer	15,765	0.61	0.49	0.00	1.00	1.00
Earnings volatility	15,765	0.49	0.01	0.48	0.49	0.51
Commercial paper/Total debt (%)	2,635	8.23	10.79	0.00	3.79	30.54
ΔCommercial paper/Bond debt$_{t-1}$ (%)	2,439	0.24	10.80	-16.04	0.00	16.71
Equity repurchases/Bond debt$_{t-1}$ (%)	15,095	4.78	10.09	0.00	0.21	24.71
Firm level: Insurer characteristics						
# Investors	15,765	68.52	94.55	1.00	30.00	269.00
%Life insurers (%)	15,765	69.53	19.48	33.33	71.05	100.00
Insurers' $\Delta \log$ total assets$_{t-1}$ (%)	15,765	-0.82	18.19	-23.36	0.81	17.80
Insurers' return on equity$_{t-1}$ (%)	15,765	8.21	5.14	0.18	8.05	16.76
Insurers' investment yield$_{t-1}$	15,765	4.27	0.71	3.11	4.27	5.34
Insurers' P&C profitability (%)	15,765	4.67	2.04	0.00	5.01	7.48
Insurers' life profitability (%)	15,765	11.62	11.68	-2.48	9.14	33.26
Insurers' life fee income (%)	15,765	3.27	2.21	0.03	3.11	7.18
Insurers' rating	15,765	2.76	0.52	1.80	2.83	3.46
Insurers' log # firms held	15,765	6.12	0.54	5.16	6.17	6.99

D.2 Insurance premiums

Table IA.20. Insurance premiums and insurers' bond purchases: Additional evidence.
Each column presents estimated coefficients from a specification of the form:

$$Y_{i,t} = \alpha \frac{\Delta \text{Premiums}_{i,t}}{\text{Total assets}_{i,t-1}} + \Gamma' C_{i,t} + \varepsilon_{i,t}$$

at the insurer-by-quarter level, where $C_{i,t}$ is a vector of control variables and fixed effects. The dependent variable in column (1) is the par value of insurer i's corporate bond purchases of old bonds, defined as those issued at least 6 days before purchase, in column (2) of new bonds, defined as those issued less than 6 days before purchases, in column (3) of all bonds net of sales, in column (4) the quarterly change in net reinsurance premiums paid to reinsurers (i.e., reinsurance business ceded less of that assumed), in column (5) the quarterly change in insurance policy reserves, in column (6) the quarterly net equity issuance, measured as the change in insurers' capital and surplus due to changes in issued stock, surplus notes, and reinsurance, all scaled by lagged total assets. The main explanatory variable is the quarterly change in insurer i's noncommercial insurance premiums scaled by lagged total assets, distinguishing between increases and decreases in premiums. Other variables are defined as in Table 2. t-statistics are shown in brackets and based on standard errors clustered at the insurer and region-by-time levels. ***, **, and * indicate significance at the 1%, 5%, and 10% levels.

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. variable:	$\frac{\text{Bond purchases (Old)}}{\text{Total assets}_{t-1}}$	$\frac{\text{Bond purchases (New)}}{\text{Total assets}_{t-1}}$	$\frac{\text{Net purchases}}{\text{Total assets}_{t-1}}$	$\frac{\Delta\text{Reinsurance}}{\text{Total assets}_{t-1}}$	$\frac{\Delta\text{Reserves}}{\text{Total assets}_{t-1}}$	$\frac{\text{Equity issuance}}{\text{Total assets}_{t-1}}$
$\frac{\Delta\text{Premiums}^{>0}}{\text{Total assets}_{t-1}}$	0.11***	0.03***	0.04***	0.67***	0.13***	0.03***
	[5.25]	[3.58]	[3.26]	[11.37]	[9.51]	[4.46]
$\frac{\Delta\text{Premiums}^{<0}}{\text{Total assets}_{t-1}}$	-0.00	-0.00	-0.02	0.78***	-0.01	-0.01**
	[-0.01]	[-0.47]	[-1.21]	[12.39]	[-1.03]	[-2.20]
Insurer controls	Y	Y	Y	Y	Y	Y
Insurer-Seasonality FE	Y	Y	Y	Y	Y	Y
Life insurer-Time FE	Y	Y	Y	Y	Y	Y
No. of obs.	32,125	32,125	45,231	45,231	45,231	45,231
No. of insurers	1,372	1,372	1,458	1,458	1,458	1,458
p-value for H0: same coefficient on decreases and increases						
	0.00	0.02	0.01	0.10	0.00	0.00

D.3 Financing activities

Table IA.21. Shareholder payouts and insurers' bond demand.

Each column presents estimated coefficients from specifications as in Equation (1) at the firm-by-quarter level. The dependent variable is the sum of the firm's dividends and equity repurchases scaled by its lagged bond debt. The main explanatory variable is the total volume of insurers' purchases of the firm's bonds in quarter t scaled by its lagged bond debt. It is instrumented by the firm's exposure to increases in potential investors' premiums, $\Delta\text{INVPremiums}^{>0}$. Colunms (3) to (6) include interactions with indicator variables for constrained firms (in the upper cross-sectional tercile of Hadlock and Pierce (2010)'s SA index) and for acquisition activity, i.e., positive acquisition expenditures. $C_{f,t}$ is a vector of control variables and fixed effect dummies. It includes the lagged share of the firm's bonds held by insurers (%Held by insurers$_{f,t-1}$) in each column. The definitions of control variables and fixed effects are as in Table 5. t-statistics are shown in brackets and based on standard errors clustered at the firm and region-by-time levels. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable:	$\frac{\text{Payouts}}{\text{Bond debt}_{t-1}}$					
$\frac{\text{Bond purchases}}{\text{Bond debt}_{t-1}}$	0.73	0.72	0.65	0.59	1.11*	1.10*
	[1.44]	[1.33]	[1.14]	[1.01]	[1.74]	[1.72]
$\frac{\text{Bond purchases}}{\text{Bond debt}_{t-1}} \times 1\{\text{Constr}\}$			0.38	0.64		
			[0.28]	[0.48]		
$1\{\text{Constr}\}$			-0.01	-0.01		
			[-0.64]	[-0.66]		
$\frac{\text{Bond purchases}}{\text{Bond debt}_{t-1}} \times 1\{\text{Acq}\}$					-0.95	-0.94
					[-1.25]	[-1.31]
$1\{\text{Acq}\}$					0.01	0.00
					[0.65]	[0.60]
Firm controls	Y	Y	Y	Y	Y	Y
Insurer controls		Y		Y		Y
Firm-Seasonality FE	Y	Y	Y	Y	Y	Y
Industry-Time FE	Y	Y	Y	Y	Y	Y
Region-Time FE	Y	Y	Y	Y	Y	Y
Insurer type-Time FE		Y		Y		Y
Insurer location-Time FE		Y		Y		Y
Insurer economy-Time FE		Y		Y		Y
First stage						
$\Delta\text{INVPremiums}^{>0}$	0.024***	0.024***	0.025***	0.025***	0.025***	0.026***
	[5.35]	[5.55]	[4.58]	[4.71]	[4.36]	[4.64]
F Statistic	95.7	86.3	42.3	41.2	43.2	37.7
No. of obs.	15,028	15,028	15,028	15,028	15,028	15,028
No. of firms	857	857	857	857	857	857

E Robustness

Table IA.22. Secondary market prices and insurers' bond demand: Robustness.
This table presents estimated coefficients from a specification of the form:

$$\text{Bond return}_{b,t} = \alpha \frac{\text{Bond purchases}_{f(b),t}}{\text{Bond debt}_{f(b),t-1}} + \Gamma' C_{b,t} + \varepsilon_{b,t}$$

at the bond-quarter level, where f is the issuer of bond b. The dependent variable is the relative difference in end-of-month prices and accrued interest of bond b in the secondary market between the last month of quarter $t-1$ and the first month of quarter $t+1$ (in %), corresponding to $x = 3$ in Figure 1. The main explanatory variable is the total volume of insurers' purchases of the firm's bonds in quarter t scaled by its lagged bond debt. It is instrumented by the firm's exposure to increases in potential investors' premiums, ΔINVPremiums$^{>0}$. $C_{b,t}$ is a vector of control variables and fixed effect dummies. It includes the lagged share of firm f's bonds held by insurers (%Held by insurers$_{f(b),t-1}$) in each column. Maturity dummies are based on the remaining time to maturity in bins (0,5], (5,10], (10,15], (15,∞). Rating dummies identify the credit rating categories AAA-AA, A, BBB, BB, B, CCC, and unrated. ΔRating dummies are based on the end-of-quarter rating change from $t-1$ to t. The definitions of other control variables and fixed effects are as in Table 5. The *Yield impact of purchasing 1% of bonds* is the change in the yield (in ppt) upon an increase in bond purchases by 1% of a firm's outstanding bonds implied by the estimated coefficient and the median duration. t-statistics are shown in brackets and based on standard errors clustered at the firm and region-by-time levels. ***, **, and * indicate significance at the 1%, 5%, and 10% levels.

	(1)	(2)	(3)
Dependent variable:	Bond return (in %)		
$\frac{\text{Bond purchases}}{\text{Bond debt}_{t-1}}$	52.14***	55.99***	53.94***
	[2.94]	[2.84]	[3.21]
Insurer controls		Y	Y
Firm controls			Y
Bond FE	Y	Y	Y
Rating-Maturity-Time FE	Y	Y	Y
ΔRating FE	Y	Y	Y
Industry-Time FE			Y
First stage			
ΔINVPremiums$^{>0}$	0.029***	0.027***	0.028***
	[3.82]	[3.64]	[4.69]
F Statistic	195.7	172.6	183.6
No. of obs.	28,963	28,963	28,951
No. of bonds	2,612	2,612	2,612
No. of firms	372	372	372
Effect of 1sd change in $\frac{\text{Bond purchases}}{\text{Bond debt}_{t-1}}$	1.13	1.21	1.16
Yield impact of purchasing 1% of bonds	0.10	0.11	0.10

Table IA.23. Corporate bond debt and insurers' bond demand: Robustness.

Each column presents estimates for the effect of insurers' bond purchases on net bond issuance analogously to Table 5. The main explanatory variable in columns (1) to (7) is the total volume of insurers' purchases of firm f's bonds in quarter t scaled by lagged bond debt, and in (8) it is the total volume of insurers' net purchases of firm f's bonds in quarter t scaled by lagged bond debt. Bond purchases are instrumented by the firm's exposure to increases in potential investors' premiums, $\Delta\text{INVPremiums}^{>0}$, excluding premiums from the firm's headquarters state and additionally (column 5) deposit-type life insurance, (column 6) states neighboring the firm's headquarters, and (column 7) customer and supplier states. In column (4), the definition of potential investors is based on the previous 10 quarters. Additional firm characteristics are earnings volatility, z-score, and lagged size, asset growth, stock return, SA index, deferred taxes, tangibility, and an indicator whether the firm paid dividends in the past 4 quarters. Additional insurer characteristics are the average potential investor's rating and logarithm of the number of issuers invested in. Insurance supply controls are the current value and 4 lags of a firm's potential investors' return on equity, investment yield, P&C and life insurance profitability, and life insurance fee income and commissions. Insurer investment yield bins are based on the quartiles of the first three principal components of the current value and 4 lags of the firm's potential investors' investment yield. Insurer profitability bins are based on the quartiles of the first three principal components of the current value and 4 lags of the firm's potential investors' insurance profitability. Social connectedness bins are based on the quartiles of Bailey et al. (2018)'s social connectedness index between a firm's and its potential investors' location. SIC1 and SIC2 refer to the 1-digit and 2-digit SIC industry classifications, respectively. The definitions of other control variables and fixed effects are as in Table 5. t-statistics are shown in brackets and based on standard errors clustered at the firm and region-by-time levels. ***, **, and * indicate significance at the 1%, 5%, and 10% levels.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable:	$\frac{\Delta\text{Bond debt}}{\text{Bond debt}_{t-1}}$							
$\frac{\text{Bond purchases}}{\text{Bond debt}_{t-1}}$	7.03***	8.49***	7.53***	7.77***	7.04***	6.58***	7.09***	
	[3.22]	[3.68]	[4.48]	[3.88]	[4.82]	[4.03]	[3.78]	
$\frac{\text{Net bond purchases}}{\text{Bond debt}_{t-1}}$								7.26***
								[3.96]
Firm controls	Y	Y	Y	Y	Y	Y	Y	Y
Insurer controls	Y	Y	Y	Y	Y	Y	Y	Y
Additional controls	Y							
Insurance supply controls			Y					
Firm-Seasonality FE	Y	Y	Y	Y	Y	Y	Y	Y
SIC2-Time FE	Y	Y	Y	Y	Y	Y	Y	Y
State-Time FE	Y		Y	Y	Y	Y	Y	Y
Rating-Time FE	Y	Y	Y	Y	Y	Y	Y	Y
Insurer type-Time FE	Y	Y	Y	Y	Y	Y	Y	Y
Insurer location-Social connectedness-Time FE	Y							
Insurer location-Time FE		Y	Y	Y	Y	Y	Y	Y
Insurer economy-Time FE	Y							
SIC1-State-Time FE		Y						
Insurer inv yield-Time FE			Y					
Insurer profitability-Time FE			Y					
First stage								
$\Delta\text{INVPremiums}^{>0}$	0.018***	0.018***	0.023***					0.022***
	[4]	[3.6]	[5.4]					[4.8]
$\Delta\text{INVPremiums}^{>0}_{1:10}$				0.021***				
				[4.7]				
$\Delta\text{INVPremiums}^{>0}_{\text{ex dep-type}}$					0.024***			
					[6]			
$\Delta\text{INVPremiums}^{>0}_{\text{ex neighbors}}$						0.022***		
						[4.9]		
$\Delta\text{INVPremiums}^{>0}_{\text{ex cust/sup}}$							0.020***	
							[4.6]	
F Statistic	43.4	45.1	67.3	67.3	99.3	78.6	64.3	73.2
No. of obs.	15,755	13,623	15,574	15,756	15,752	15,726	15,747	15,756
No. of firms	871	783	869	871	870	871	871	871

Table IA.24. Total corporate investment and insurers' bond demand: Robustness.

Each column presents estimates for the effect of insurers' bond purchases on the firm's total investment analogously to column (3) in Table 8. The main explanatory variable in columns (1) to (8) is the total volume of insurers' purchases of firm f's bonds in quarter t scaled by lagged bond debt, and in (9) it is the total volume of insurers' net purchases of firm f's bonds in quarter t scaled by lagged bond debt. Instruments, control variables, and fixed effects are defined as in Table IA.23. t-statistics are shown in brackets and based on standard errors clustered at the firm and region-by-time levels. ***, **, and * indicate significance at the 1%, 5%, and 10% levels.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variable:	$\frac{\text{Total Investment}}{\text{Bond debt}_{t-1}}$								
$\frac{\text{Bond purchases}}{\text{Bond debt}_{t-1}}$	5.09***	6.93***	7.66***	6.60***	6.63***	6.63***	6.63***	6.63***	
	[4.46]	[3.00]	[2.87]	[3.76]	[3.54]	[3.54]	[3.54]	[3.54]	
$\frac{\text{Bond purchases (prim)}}{\text{Bond debt}_{t-1}}$	-6.10***								
	[-3.36]								
$\frac{\text{Net bond purchases}}{\text{Bond debt}_{t-1}}$									6.91***
									[3.55]
Firm controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
Insurer controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
Additional controls		Y							
Insurance supply controls				Y					
Firm-Seasonality FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
SIC2-Time FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
State-Time FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Rating-Time FE		Y	Y	Y	Y	Y	Y	Y	Y
Insurer type-Time FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Insurer location-Time FE	Y		Y	Y	Y	Y	Y	Y	Y
Insurer location-Social connectedness-Time FE		Y							
Insurer economy-Time FE	Y	Y							
SIC1-State-Time FE			Y						
Insurer inv yield-Time FE				Y					
Insurer profitability-Time FE				Y					
First stage									
$\Delta\text{INVPremiums}^{>0}$	0.030***	0.018***	0.018***	0.023***					0.022***
	[8.2]	[3.97]	[3.61]	[5.42]					[4.77]
$\Delta\text{INVPremiums}^{>0}_{1:10}$					0.023***				
					[5]				
$\Delta\text{INVPremiums}^{>0}_{\text{ex dep-type}}$						0.023***			
						[5]			
$\Delta\text{INVPremiums}^{>0}_{\text{ex neighbors}}$							0.023***		
							[5]		
$\Delta\text{INVPremiums}^{>0}_{\text{ex cust/sup}}$								0.023***	
								[5]	
F Statistic	524.5	43.4	45.1	67.3	78.2	78.2	78.2	78.2	73.2
No. of obs.	15,765	15,755	13,623	15,574	15,756	15,756	15,756	15,756	15,756
No. of firms	871	871	783	869	871	871	871	871	871

Table IA.25. Corporate acquisitions and insurers' bond demand: Robustness.

Each column presents estimates for the effect of insurers' bond purchases on the firm's acquisition expenditures analogously to column (5) in Table 8. The main explanatory variable in columns (1) to (8) is the total volume of insurers' purchases of firm f's bonds in quarter t scaled by lagged bond debt, and in (9) it is the total volume of insurers' net purchases of firm f's bonds in quarter t scaled by lagged bond debt. Instruments, control variables, and fixed effects are defined as in Table IA.23. t-statistics are shown in brackets and based on standard errors clustered at the firm and region-by-time levels. ***, **, and * indicate significance at the 1%, 5%, and 10% levels.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variable:	$\frac{\text{Acquisitions}}{\text{Bond debt}_{t-1}}$								
$\frac{\text{Bond purchases}}{\text{Bond debt}_{t-1}}$	2.91***	4.21**	3.81*	3.43**	3.47**	3.47**	3.47**	3.47**	
	[3.01]	[2.36]	[1.94]	[2.39]	[2.43]	[2.43]	[2.43]	[2.43]	
$\frac{\text{Bond purchases (prim)}}{\text{Bond debt}_{t-1}}$	-2.99*								
	[-1.94]								
$\frac{\text{Net bond purchases}}{\text{Bond debt}_{t-1}}$									3.62**
									[2.44]
Firm controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
Insurer controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
Additional controls		Y							
Insurance supply controls				Y					
Firm-Seasonality FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
SIC2-Time FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
State-Time FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Rating-Time FE		Y	Y	Y	Y	Y	Y	Y	Y
Insurer type-Time FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Insurer location-Time FE	Y		Y	Y	Y	Y	Y	Y	Y
Insurer location-Social connectedness-Time FE		Y							
Insurer economy-Time FE	Y	Y							
SIC1-State-Time FE			Y						
Insurer inv yield-Time FE				Y					
Insurer profitability-Time FE				Y					
First stage									
$\Delta\text{INVPremiums}^{>0}$	0.030***	0.018***	0.018***	0.023***					0.022***
	[8.2]	[3.97]	[3.61]	[5.42]					[4.77]
$\Delta\text{INVPremiums}^{>0}_{1:10}$					0.023***				
					[5]				
$\Delta\text{INVPremiums}^{>0}_{\text{ex dep-type}}$						0.023***			
						[5]			
$\Delta\text{INVPremiums}^{>0}_{\text{ex neighbors}}$							0.023***		
							[5]		
$\Delta\text{INVPremiums}^{>0}_{\text{ex cust/sup}}$								0.023***	
								[5]	
F Statistic	524.5	43.4	45.1	67.3	78.2	78.2	78.2	78.2	73.2
No. of obs.	15,765	15,755	13,623	15,574	15,756	15,756	15,756	15,756	15,756
No. of firms	871	871	783	869	871	871	871	871	871

Table IA.26. Corporate capital expenditures and insurers' bond demand: Robustness.

Each column presents estimates for the effect of insurers' bond purchases on the firm's capital expenditures analogously to column (7) in Table 8. The main explanatory variable in columns (1) to (8) is the total volume of insurers' purchases of firm f's bonds in quarter t scaled by lagged bond debt, and in (9) it is the total volume of insurers' net purchases of firm f's bonds in quarter t scaled by lagged bond debt. Instruments, control variables, and fixed effects are defined as in Table IA.23. t-statistics are shown in brackets and based on standard errors clustered at the firm and region-by-time levels. ***, **, and * indicate significance at the 1%, 5%, and 10% levels.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variable:					$\frac{\text{Acquisitions}}{\text{Bond debt}_{t-1}}$				
$\frac{\text{Bond purchases}}{\text{Bond debt}_{t-1}}$	1.00***	0.99**	1.63**	1.44***	1.44***	1.44***	1.44***	1.44***	
	[3.84]	[2.17]	[2.51]	[3.19]	[3.16]	[3.16]	[3.16]	[3.16]	
$\frac{\text{Bond purchases (prim)}}{\text{Bond debt}_{t-1}}$	-1.39***								
	[-3.48]								
$\frac{\text{Net bond purchases}}{\text{Bond debt}_{t-1}}$									1.50***
									[3.15]
Firm controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
Insurer controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
Additional controls		Y							
Insurance supply controls				Y					
Firm-Seasonality FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
SIC2-Time FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
State-Time FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Rating-Time FE		Y	Y	Y	Y	Y	Y	Y	Y
Insurer type-Time FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Insurer location-Time FE	Y		Y	Y	Y	Y	Y	Y	Y
Insurer location-Social connectedness-Time FE		Y							
Insurer economy-Time FE	Y	Y							
SIC1-State-Time FE			Y						
Insurer inv yield-Time FE				Y					
Insurer profitability-Time FE				Y					
First stage									
$\Delta\text{INVPremiums}^{>0}$	0.030***	0.018***	0.018***	0.023***					0.022***
	[8.2]	[3.97]	[3.61]	[5.42]					[4.77]
$\Delta\text{INVPremiums}^{>0}_{1:10}$					0.023***				
					[5]				
$\Delta\text{INVPremiums}^{>0}_{\text{ex dep-type}}$						0.023***			
						[5]			
$\Delta\text{INVPremiums}^{>0}_{\text{ex neighbors}}$							0.023***		
							[5]		
$\Delta\text{INVPremiums}^{>0}_{\text{ex cust/sup}}$								0.023***	
								[5]	
F Statistic	524.5	43.4	45.1	67.3	78.2	78.2	78.2	78.2	73.2
No. of obs.	15,765	15,755	13,623	15,574	15,756	15,756	15,756	15,756	15,756
No. of firms	871	871	783	869	871	871	871	871	871

F Additional analyses

F.1 Insurance premiums and socioeconomic characteristics

In this section, I explore insurance demand driven by socioeconomic characteristics. For this purpose, I rely on insurer-state-level quarterly noncommercial insurance premiums from 2011q1 to 2018q4 and socioeconomic characteristics for U.S. states, retrieved from the U.S. Bureau of Economic Analysis (BEA) and U.S. census. I include as a potential economic determinant of insurance demand the log total income per capita at the state-quarter level in the lagged 4 quarters (retrieved from the U.S. BEA). I include as potential social determinants of insurance demand the level of education, measured by the share of residents with a bachelor's degree (among those aged at least 25 years), the share of seniors (residents aged at least 65 years), the share of married residents (among those aged at least 15 years), the share of divorced residents (among those aged at least 15 years), and the share of married households with children - all retrieved from the U.S. census, recorded at the state-by-year level, and lagged by one calendar year relative to insurance premiums.

Table IA.27 reports the results of regressions of log insurance premiums on these characteristics. I absorb time-invariant heterogeneity in insurers' activity across states by including insurer-by-state fixed effects and aggregate as well as region-specific shocks by including region-by-time fixed effects. Thus, the coefficients are identified from local variation in socioeconomic characteristics. In an additional specification, I also include insurer-by-time fixed effects, which absorb any insurer-specific shocks, such as to their financial strength or investment success.

I find that socioeconomic characteristics significantly correlate with insurance premiums. Income is particularly important for P&C insurance, as a 1% increase in income associated with an approximately 1% increase in insurance premiums. Insurance premiums for annuities correlate most with education and family status, suggesting that households are more inclined to save for retirement when their members are more educated or married without children. The presence of children significantly reduces annuity premiums, consistent with higher opportunity cost of retirement saving. Insurance premiums for pure life insurance are most correlated with a higher share of seniors, consistent with the higher mortality risk in this age group.

Table IA.27. Insurance premiums and socioeconomic characteristics.
Each column presents estimates from a specification of the form:

$$\log \text{Premiums}_{i,s,t} = \alpha \ X_{i,s,t} + \Gamma' C_{i,s,t} + \varepsilon_{i,s,t}$$

at the insurer-by-state-by-quarter level, where $C_{i,s,t}$ is a vector of fixed effect dummies. The sample includes U.S. states from 2011q1 to 2018q4. The dependent variable is the log total volume of noncommercial insurance premiums for (columns 1-2) P&C insurance, (columns 3-4) annuities, and (columns 5-6) pure life insurance. The explanatory variables are the log total income per capita in the lagged 4 quarters and the share of the population with a bachelor's degree, aged at least 65 years, married, and divorced, and the share of households with children - which are all lagged by one calendar year. Columns (2), (4), and (6) include only insurers that are active in at least two states at a given point in time. t-statistics are shown in brackets and based on standard errors clustered at insurer and state-by-time levels. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable:	log Insurance premiums					
Type:	P&C		Annuity		Pure life	
log Income	0.99***	1.01***	-0.12	0.22	0.23**	0.21**
	[5.16]	[5.77]	[-0.42]	[0.98]	[2.30]	[2.36]
% Bachelor	1.08*	0.64	1.64**	1.72**	0.75**	0.66**
	[1.93]	[1.22]	[1.98]	[2.14]	[2.55]	[2.24]
% $\geq$ 65 yrs	-0.06	-0.82	0.85	1.04	1.98**	1.78**
	[-0.03]	[-0.49]	[0.38]	[0.53]	[2.40]	[2.30]
% Married	1.33*	0.85	1.48*	1.28	0.03	0.02
	[1.88]	[1.23]	[1.66]	[1.51]	[0.08]	[0.05]
% Married w/ kids	-1.05	-0.54	-1.93*	-1.97**	-0.24	-0.32
	[-1.26]	[-0.70]	[-1.80]	[-1.98]	[-0.55]	[-0.73]
% Divorced	-2.26**	-1.82*	-0.59	-0.26	-0.67	-0.63
	[-2.32]	[-1.95]	[-0.43]	[-0.20]	[-1.37]	[-1.27]
Insurer-State FE	Y	Y	Y	Y	Y	Y
Region-Time FE	Y	Y	Y	Y	Y	Y
Insurer-Time FE		Y		Y		Y
No. of obs.	354,827	345,250	233,995	232,114	485,304	483,482
No. of insurers	959	658	389	330	482	420

F.2 Insurance premiums and insurers' investment return

A potential concern about the identification is that bond prices could directly affect insurance premiums through insurers' investment return. In this case, lower expected investment returns associated with higher current bond prices would correlate with higher insurance markups (Knox and Sørensen, 2020). This section explores the correlation between expected investment returns and total noncommercial insurance premiums.

I follow Knox and Sørensen (2020) and use insurers' reported investment yield (in percent) as the main measure for expected investment returns. In column (1) of Table IA.28, I find a significantly positive correlation between investment yield and insurance premiums, controlling for aggregate shocks with time fixed effects and for time-invariant heterogeneity across life and P&C insurers by including insurer type fixed effects. The coefficient decreases in size and becomes insignificant upon the inclusion of insurer fixed effects in column (2). Thus, time-invariant differences across insurers explain the positive correlation between investment yield and insurance premiums, i.e., larger insurers tend to have a larger investment yield on average. The coefficient remains insignificant when I control for differential trends for P&C and life insurers in column (3).

Thus, the correlation between investment yield and insurance premiums tends to be positive but insignificant once controlling for cross-sectional differences. This result suggests that it is implausible that an increase in bond prices, which is associated with a *decrease* in expected investment returns, leads to an increase in insurance premiums, as it would imply a negative correlation between investment return and insurance premiums.

It is important to note that these results are not in conflict with those of Knox and Sørensen (2020). Knox and Sørensen (2020) document a significantly negative correlation between investment yield and insurance *price*, i.e., holding insurance volume constant. The extent to which changes in prices translate into changes in the total volume of premiums written depends on the price elasticity of insurance demand.

Table IA.28. Insurers' investment return and insurance premiums.
Each column presents OLS estimates for a specification of the form:

$$\log(\text{Insurance premiums}_{i,t}) = \alpha \text{Investment yield}_{i,t} + \Gamma' C_{i,t} + \varepsilon_{i,t}$$

at the insurer-by-quarter level, where $C_{i,t}$ is a vector of fixed effects. Each column presents estimates for the correlation between insurers' investment yield and noncommercial insurance premiums written. t-statistics are shown in brackets and based on standard errors clustered at the insurer level. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

	(1)	(2)	(3)
Dependent variable:	log(Insurance premiums)		
Investment yield	0.37***	0.01	0.02
	[11.68]	[1.45]	[1.55]
Time FE	Y	Y	
Life insurer FE	Y		
Insurer FE		Y	Y
Life insurer-Time FE			Y
No. of obs.	47,514	47,514	47,514
No. of insurers	1,500	1,500	1,500