On the Dynamics of Corporate Bond Ownership

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Abstract

We examine the dynamic ownership structure of corporate bonds after initial issuance. We find that as bonds "season", the market learns more about them. This learning leads to less concentrated bond ownership over time. Specifically, learning induces a shift in bond ownership from more informed short-term investors to less informed long-term investors. This shift in ownership is accompanied by reduced trading volume and lower expected returns. Utilizing firm-level credit rating reports from Standard & Poor's, we identify that the source of learning is related to macro- and industry-level information and the term structure of interest rate rather than firm-level cash flow news. Our results suggest that regulations that facilitate easier access to information and better learning, such as centralizing corporate bond trading, could encourage more participation and benefit a wider spectrum of investors.

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1. Introduction

One key question in the finance literature is what shapes the evolution of a firm's ownership structure and the implications of ownership structure asset pricing. This question has traditionally been cast in terms of equity ownership (e.g., Stulz, 2005; Helwege, Pirinsky and Stulz, 2007; Holderness, 2009; Foley and Greenwood, 2009). By contrast, much less attention has been devoted to corporate bond ownership, even though the recent financial crisis has highlighted its importance (e.g., Greenwood and Hanson, 2013; Massa, Yasuda and Zhang, 2013). The presence of bond owners who are increasingly subject to withdrawal shocks, for instance, has been shown to fuel fire-sale runs (e.g., Ellul, Jotikasthira and Lundblad, 2011) and sudden liquidity disruptions in the financial markets. It is therefore crucial for policy makers and market participants to understand what drives bond ownership as well as its dynamics and heterogeneity.

We undertake this task and investigate the dynamic of corporate bond ownership as the bond "seasons" – i.e., as the time span that the specific bond has been on the market lengthens. We argue that the impact of seasoning on bond ownership is linked to the process of information diffusion regarding the bond itself. We begin with the premise that the corporate bond market has a particularly opaque information structure and that the seasoning of a bond may affect its information flow and, as a consequence, its ownership structure. Indeed, even if information about the firm is public and widely available, information regarding its bonds is more difficult to both obtain and process. Bond features such as credit ratings, covenants, collateral, and specific clauses effectively make each single bond unique and costly to analyze. Moreover, the effects of bond complexity are exacerbated by relatively higher transaction costs and by the fact that the overwhelming majority of corporate bonds (more than 95%) are traded over-the-counter. All these features make the efficient dissemination or processing of pricing information more difficult (e.g., Bessembinder, Maxwell and Venkataraman, 2006; Edwards, Harris and Piwowar, 2007; Goldstein, Hotchkiss and Sirri, 2007; Bessembinder and Maxwell, 2009; Bao, Pan and Wang, 2011; Lin, Wang and Wu, 2011).

Because of the opacity of the information environment, we expect a newly issued bond to be initially held by relatively more informed investors (e.g., hedge funds and active mutual funds) who have the ability to properly price the bond and are more willing to invest in the presence of higher information uncertainty. It is indeed generally acknowledged that certain savvy investors, such as hedge funds, are able to process information better than the market (Kim and Verrecchia, 1994; Kandel and Pearson, 1995; Engelberg, Reed and Ringgenberg, 2012). As information about bond's characteristics and risk profile as well as their link to firm fundamentals begin to be processed in the market, the nature of ownership and its degree of concentration will change. The ensuing higher degree of information in the market will encourage the participation of relatively less informed investors. The ensuing spread of ownership of the bond from more informed to less informed investors will make ownership to become less concentrated. The lower information risk will lead bond returns to drop as well. At the same time, given that the less informed investors are less likely to frequently trade their bonds (e.g., Yan and Zhang, 2009), their increased participation will reduce trading volume. These considerations define our first hypothesis: the "*learning hypothesis*".

However, the reduction in ownership concentration is not the only equilibrium outcome when some savvy investors in an opaque market can process information better than others. Information asymmetry between these savvy investors and the rest of the market, for instance, can increase rather than decrease, which discourages less informed liquidity traders from participating in the market (Kim and Verrecchia, 1994). In this scenario, bond ownership will become increasingly concentrated in the hands of those initial investors who can excel at processing information when the bond seasons. Liquidity may still decrease—not because of reduced trading needs of less informed investors, but due to the unwillingness of less-informed liquidity traders to participate. The most intriguing consequence is about return: in this scenario expected bond returns need to increase in order to compensate for the information risk faced by less informed traders. Hence, this alternative set of predictions, which we can refer to as the "*asymmetric information hypothesis*", portraits a very different type of bond market. Even though bond ownership plays a pivotal role in both hypotheses, ownership dynamics differ drastically, which consequently leads to other observable differences in bond returns and liquidity.

We test these two competing hypotheses by focusing on a comprehensive sample of US corporate bonds over the 1998-2007 period. After carefully controlling for bond- and firm-specific characteristics – including maturity and credit risk – we find that bond seasoning is generally related to reduced ownership concentration. In particular, when a bond becomes seasoned – i.e., when the bond becomes greater than two years old – the degree of its ownership concentration declines by 2.23% to 5.91%, depending on the empirical specifications. These results provide preliminary support for the *learning hypothesis* as opposed to the *asymmetric information hypothesis*.

Next, we conduct three tests to directly link declined ownership concentration to learning. In the first test, we construct four measures to proxy for the learning difficulty for each specific bond. If declined ownership concentration is the result of learning, we expect the decline to be slower when it is more difficult for the market to learn. The first proxy we use in this context is the dispersion in bond credit ratings by the three major rating agencies. When these rating agencies disagree, the market will find it more difficult to learn about the risk of the bond.[4] Our second proxy exploits the fact that the existence of many outstanding bonds provides information. Therefore the proxy is a dummy variable that equals one if it is the first bond issued by the firm and zero otherwise. The third and fourth proxies are dummy variables that take a value of one if the total dollar value and the total number of existing bonds issued by the same firm, respectively, are below the 30th percentile of the entire sample and zero otherwise. The last three variables aim to capture the intuition that learning about a particular bond can be more difficult when investors cannot use other bonds from the same firm to glean some information – i.e., when these dummy variables take a value of one. We find that all four proxies for learning difficulty significantly slow down the impact of seasoning on reducing ownership concentration, suggesting that the decline of holding concentration over bond seasoning is indeed the result of a learning effect.

Next, we provide evidence that our findings are robust when we control for changes in credit risk, maturity, and other bond characteristics. In other words, the interaction between these variables and bond seasoning does not affect our main results. It is particularly important that our results are not a manifestation of the maturity effect as it may be argued that seasoning is negatively related to maturity because corporate bonds typically have fixed maturities. Our results show that the effects of seasoning and maturity do not absorb one another, suggesting that these two characteristics play different economic roles with respect to learning.[5]

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[4] Bongaerts, Cremers and Goetzmann (2012) find that the third credit rating agency, Fitch, can be a tie-breaker to provide the market with new credit information when the top two major rating agencies, Moody's and Standard & Poor's, have the same ratings.

[5] We provide three specific examples to demonstrate the difference between seasoning and maturity in relation to learning. First, if a bond has a long maturity, although its maturity reduces as the bond seasons, the majority of the learning about the bond occurs in the first few years of the life of the bond. Hence, the seasoning effect plays a stronger role for learning about information than the maturity effect. Second, when a bond has a short maturity, the learning may not stop when the bond reaches maturity, whereas the learning can still be strongly related to the seasoning of the bond. Third, some institutional investors may want to hold bonds with preferred durations due to immunization investment strategies. Hence, their learning about the bond is primarily based on the characteristics of the bond instead

But if the market as a whole learns about a bond over time as we hypothesize, what kind of information does it learn? Our third set of tests addresses this issue. We resort to the intuition that, compared to equity holders, bond holders often need to pay more attention to firms' exposure to industry- and macro-level uncertainty, because credit events and adverse price movements can often be triggered by industry- and macro-level news (Greenwood and Hanson, 2013; Massa, Yasuda and Zhang, 2013; Benzoni, Collin-Dufresne and Goldstein, 2015). Accordingly, we pull out industry/macro information relevant to a firm from its *credit rating reports* issued by Standard & Poor's, and construct two linguistic-based "ambiguity" measures based on such information. A higher degree of ambiguity in such information reflects more uncertainty of the firm's credit risk (as the information is pulled out from its credit rating reports) particularly related to its macro exposure (as the context of information focuses on descriptions of industry/macro environment). We find that, for the two measures, the degree of ambiguity declines as a bond seasons, suggesting that the market – as proxied by the rating agencies themselves – learn about the potential impact of industry and macroeconomic news on the risk and value of corporate bonds.

As a Placebo test, we also consider the degree of ambiguity regarding a firm's cash flow news. Given that the equity market provides information regarding a firm's cash flows, learning about this specific source of uncertainty is less likely over the life cycle of a particular bond. And indeed, we do find no relation between it and to bond seasoning: of ambiguity regarding a firm's cash flow news does not decay over the seasoning of corporate bonds.

But is it possible that investors completely learn about the macro exposure of a firm's credit risk at some point, such that, after that moment, new bonds do not allow any new learning? We

of the maturity of the bond. Their learning process can thus be better captured by the seasoning effect than the maturity effect.

argue that this is not likely to be the case as credit risk as well as its exposure to macro environment change dynamically and are largely affected by the underlying economic state of the economy and macro conditions (e.g., Benzoni, Collin-Dufresne and Goldstein, 2015; Duan, Sun and Wang, 2012). More specifically, the term structure of interest rates and its associated supply of government bonds are known to affect the maturity choice of corporate bonds (Greenwood, Hanson and Stein, 2010) as well as the firms' default risk across different horizons (Duan, Sun and Wang, 2012). We therefore expect that a shock to the term structure of interest rate will negatively affect the speed for investors to learn and resolve the ambiguity related to the exposure of a firm's credit risk to macro factors. This will slow down the process of ownership transition related to bond seasoning.

To verify this conjecture, we revisit the above ambiguity test, inserting an interaction term between bond seasoning and indicators of shocks to the term structure. In line with our working hypothesis, we find that the reduction in information ambiguity slows down in the presence of large term structure shocks. Similarly, terms structure shocks reduce the process of reduction in ownership concentration. These results provide consistent evidence of a dynamic dimension of learning as its content —the macro exposure of credit risk—is affected by changes in important state variables such as the term structure of interest rates.

After we validate the learning channel, we investigate the implications of the *learning hypothesis* in terms of investor clientele, bond returns, and bond liquidity. First, we detail ownership changes in terms of short-term and long-term institutional investors. Given that short-term institutional investors tend to be more informed (e.g., Yan and Zhang, 2009), the *learning hypothesis* predicts an ownership shift from short-term investors to long-term investors as the bond seasons. And, indeed, we find this pattern in the data: a seasoning of a bond by more than two years is accompanied by a 10% increase in the ownership of long-term institutional investors, while the ownership of short-term investors decreases accordingly. Furthermore, ownership concentration among short-term investors also declines with bond seasoning, which is exactly the opposite of what the *asymmetric information hypothesis* predicts.

Because long-term investors typically buy and hold as opposed to engaging in frequent trading, the shift from short-term to long-term investors mechanically should reduce trading volume. This assertion is empirically confirmed as bond seasoning is typically associated with a reduction in trading volume of more than 15%, and this reduction is mostly concentrated in bonds with high ownership by long-term investors. Higher information and greater presence of long term investors is related to a decline in the expected bond return, in line with the intuition that seasoning lowers information asymmetry and its associated risk premium, particularly from the perspective of long-term investors. However, the lower trading is also associated with lower liquidity. Indeed, the Roll's illiquidity measure increases with bond seasoning, and the increase is concentrated in the bonds with more long-term investors. Both the patterns in liquidity and bond returns are consistent with the *learning hypothesis*.

Our paper contributes to the literature in three distinct ways. First, our results contribute to the literature on ownership structure and its dynamics (Stulz, 1988; 1990), which is a topic that is more commonly studied regarding equity ownership. For example, Helwege, Pirinsky and Stulz (2007) show that the insider ownership of IPO firms declines as these firms become more mature. Holderness (2009) demonstrates that most U.S. public firms still have significant blockholders and that U.S. public firms actually have similar or more concentrated ownership structures than firms in other countries – notwithstanding that the U.S. has a good investor protection infrastructure. Foley and Greenwood (2009) find that equity ownership concentration falls after an IPO in countries with strong investor protection because firms in these countries continue to raise capital. This finding contrasts with the prior literature that documents a strong relation between concentration and investor protection in various cross sections of firms (e.g., La Porta, Lopez-de-Silanes, Shleifer, 1999; Dyck and Zingales, 2004). Our study establishes a link between the dynamics of bond ownership and bond-related information. We are among the first to document that bond ownership concentration declines as bonds season due to the learning about the bond that occurs during its life-cycle. The fact that learning is an important determinant of the dynamics of bond holding concentration is a new contribution to the literature.

Second, we shed new light on the role of different institutional investors in the bond market and firms' debt financing choices. Firms' choices regarding types of debt financing have traditionally been explained by firm characteristics such as credit ratings, default probability, risk, and asset tangibility (e.g., Diamond, 1984; James, 1987; James and Wier, 1988; Diamond, 1991; Rajan, 1992; Houston and James, 1996; Cantillo and Wright, 2000; Denis and Mihov, 2003). Our results suggest that one important component of firms' choices in their debt portfolios might be related to investor clientele in general and investor horizons in particular. We contribute to the literature on debt market segmentation (e.g., Gan, 2007; Mian, 2008; Sufi, 2009; Leary, 2009; Lemmon and Roberts, 2010) and to the emerging literature on the power and influence of institutional investors in the corporate bond market (Chen, Ferson and Peters, 2010; Manconi, Massa and Yasuda, 2012).

Finally, by suggesting that learning critically affects bond investors, our results also have important policy implications. Our findings support regulators' proposals to make bonds publicly tradable in regulated stock exchanges as opposed to privately exchanged over the counter. More generally, because learning is the dominant factor affecting the ownership structures of corporate bonds, regulations that facilitate easy access to information and better learning might encourage more participation from a wider spectrum of investors, which would benefit both investors and firms issuing corporate bonds.

The rest of the paper is organized as follows. Section 2 develops the empirical hypotheses. Section 3 presents the details of the data and the variables that we use in our analysis. Section 4 presents the main empirical findings and performs robustness tests. Section 5 explores the nature of the learnt information and Section 6 discusses the implications of the findings. Section 7 concludes.

2. Hypotheses Development

We now lay out two competing hypotheses. The *learning hypothesis* posits that as a bond seasons – i.e., as it remains in the market for a longer period of time – bond investors become more informed about it. We know that in the presence of uncertainty concentration among the lenders as well as equity owners is higher (Sufi, 2007; Byun, Hwang, and Lee, 2011). Therefore, this reduced information ambiguity leads to more dispersed ownership and a negative correlation between ownership concentration and bond seasoning. The rebalanced ownership increases the fraction of less informed investors, including long-term investors.

The alternative hypothesis (the *asymmetric information hypothesis*) as well posits that seasoning increases the market informativeness of a particular bond. However, this increase occurs under this hypothesis not because information becomes gradually diffused in the market but because some investors are more capable of processing public information. For example, hedge funds and mutual funds are better at elaborating information regarding the bond because they spend resources processing existing public information to create more precise and valuable semipublic information that they then trade upon (e.g., Kim and Verrecchia, 1994; Lin, Massa and Zhang, 2014). Thus, their trading increases not only the informativeness of the bond price but also the information asymmetry between informed investors and the market. The ensuing adverse selection discourages less informed discretionary liquidity traders (such as long-term institutional investors) from participating in the market. Even among the initial pool of bond investors, those who turn out to be less able to process information will reduce their holdings. Overall, this process will lead to higher ownership concentration. We summarize the two hypotheses as follows:

H1 (The Learning Hypothesis): Bond seasoning leads to less concentrated bond ownership.

H2 (The Asymmetric Information Hypothesis): Bond seasoning leads to more concentrated bond ownership.

Several properties related to learning can help further differentiate the two hypotheses. According to the *learning hypothesis*, a higher learning cost/difficulty should reduce learning and, as a result, the speed of ownership dilution. Furthermore, to the extent that learning resolves ambiguities in public information, seasoning should lead to declines in the level of such ambiguities in publically released information related to the bond. By contrast, according to the *asymmetric information hypothesis*, higher learning cost/difficulty will increase the benefits for the few informed investors who are willing or able to process information about the bond, which should therefore increase the incentives of such investors to invest in the bond (e.g., Gilson, 1990). This process would thus enhance information asymmetry and lead to increased ownership concentration. The increased information asymmetry also implies that, other things being equal, public information about the bond will become more ambiguous. We summarize these properties in the following two corollaries.

Corollary 1 (Learning Difficulty): Learning difficulty reduces the speed of ownership dilution under the Learning Hypothesis and enhances the speed of ownership concentration under the Asymmetric Information Hypothesis.

Corollary 2 (Ambiguity of Public Information): The ambiguity of public information decreases with bond seasoning under the Learning Hypothesis and increases with bond seasoning under the Asymmetric Information Hypothesis.

The two hypotheses also have different implications in terms of investor clientele, bond liquidity and expected returns. Because informed investors typically trade more actively in the short term (e.g., Yan and Zhang, 2009), the two competing hypotheses have exactly the opposite implications in terms of the dynamics of investor clientele. Under the *learning hypothesis*, the shift in ownership from more informed to less informed investors spreads ownership from short-term to long-term investors as the bond seasons. However, under the *asymmetric information hypothesis*, bond seasoning increases information asymmetry and induces a further concentration of ownership toward the (even fewer) more informed short-term investors (e.g., Gilson, 1990). These considerations lead to the following corollary:

Corollary 3 (Investor Clientele): Bond ownership by long-term investors increases with bond seasoning under the Learning Hypothesis. Bond ownership concentrates even more in the hands of more informed short-term investors with bond seasoning under the Asymmetric Information Hypothesis.

Notably, both hypotheses imply a negative correlation between bond seasoning and trading volume, albeit for different reasons. Under the *learning hypothesis*, trading volume decreases with bond seasoning because the investor clientele is generally less active in terms of trading – i.e., long-term investors. Under the *asymmetric information hypothesis*, trading volume drops with seasoning because the participation of discretionary liquidity traders is discouraged by the information advantage of the informed investors (Kim and Verrecchia, 1994; Lin, Massa and Zhang, 2014). To differentiate the two hypotheses, we note that the reduction in liquidity is related to different types of investors: under the *learning hypothesis*, the (negative) seasoning effect on liquidity is enhanced by long-term investors' ownership; by contrast, under the *asymmetric information hypothesis*, the (negative) seasoning effect on liquidity is enhanced by short-term investors' ownership.

Finally, the two competing hypotheses have different implications for bond returns: all other things being equal, a decrease (increase) in information asymmetry leads to a reduction (increase) in the expected return required to compensate the less informed long-term investors for holding the bond. Moreover, such changes in return compensation should be more prominent when more long-term investors have invested in the bond. The liquidity and return implications can be summarized in the following corollary:

Corollary 4 (Bond Liquidity and Returns): Under the Learning Hypothesis, liquidity and bond returns decrease with bond seasoning, particularly when there are more long-term investors. In contrast, under the Asymmetric Information Hypothesis, liquidity and bond returns increase with bond seasoning, particularly when there are more long-term investors.

Before bringing these hypotheses to the data, we describe our data and the main variables.

3. Data and Construction of Variables

We use data from various databases. The bond holding data come from Lipper eMAXX for the 1998Q1-2008Q2 period. The database contains detailed fixed-income holdings for nearly 20,000 entities that include U.S. and European insurance firms; U.S., Canadian, and European mutual funds; and leading U.S. banks as well as public pension funds. This database provides information regarding the quarterly holdings of more than 40,000 fixed-income issuers, with USD $5.4 trillion in total fixed income at par value. We focus on U.S.-issued corporate bonds held by U.S. institutions. This sample has approximately 1,200 institutional investors every quarter, holding a total face value of approximately USD $1.8 billion on average. For these institutions, eMAXX reports the holdings based on regulatory disclosure to the National Association of Insurance Commissioners (NAIC) for insurance companies and to the Securities and Exchange Commission (SEC) for mutual funds, asset managers and public pension funds; it also reports voluntary disclosure by the major private pension funds. A detailed description of the data is provided in Dass and Massa (2014).

The eMAXX database reports bond holdings both at the level of the institutional investor and at the individual fund level. "Funds" are the individual pools of assets managed by institutional investors. Institutional investors are investment companies (e.g., Fidelity or Prudential), and their holdings reflect their aggregate bond holdings across their various funds. Among institutional investors, insurance companies and mutual funds are the predominant investors in corporate bonds, together accounting for approximately 80% of all institutional bond holdings. Institutional investors can hold multiple maturities either through maturity-focused funds (e.g., Fidelity's *Short-term Bond Fund*) or through funds that invest across maturities (e.g., Prudential's *Diversified Bond Portfolio*). However, not all the institutional investors are organized as a family of multiple funds. Some institutional investors are organized as a single entity that holds all its investments in one portfolio. In our sample, 40% of all institutional investors' bond holdings by face value are accounted for by bond holdings of distinct funds. This distribution implies that the remaining 60%

of bonds by face value are held by institutional investors that are organized as a single portfolio rather than as a family of funds.[6]

In the case of mutual fund families, in Lipper eMAXX, each "fund" represents an individual mutual fund. In the case of insurance companies, however, funds represent two different investment vehicles. The first is variable annuity funds, which offer an investment instrument that combines the attributes of mutual fund investment and insurance. The second type of insurance fund includes property/damage and life-insurance funds. These investment vehicles are used by insurance companies to invest money set aside for future claims.

We focus on straight corporate bonds and exclude preferred bonds as well as government or government sponsored enterprise bonds and callable bonds. Bond characteristics such as age, coupon, credit rating, maturity, issuance size, and covenants are drawn from the Mergent Fixed Income Database (FISD). This database provides extensive information regarding approximately 68,000 bond issues and includes bonds issued by U.S. government agencies such as Fannie Mae and Freddie Mac, Yankee bonds issued by foreign entities, etc. The U.S. corporate bond issues from Mergent FISD that can be matched with Lipper's eMAXX bond-holdings data result in approximately 2,500 issues.

More than 95% of all Mergent FISD bond issues by face value are covered in Lipper eMAXX. The missing 5% consist of bonds issued by foreign firms (i.e., Yankee bonds). For the bond-issuing firms in our sample, the bonds in Lipper represent a significant fraction of their overall debt (as reported in Compustat). The ratio of the face value of bonds in Lipper to debt in Compustat is 58%, on average. The residual is debt in the form of bank loans and bonds with maturities shorter than

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[6] As long as the single-portfolio investor holds bonds of multiple maturities, the investor can have a preference for high-MV firms due to the efficiency in information collection – i.e., our argument also holds for single-portfolio investors.

one year. The pricing data for the corporate bonds are obtained from NAIC and TRACE. After merging with these databases, we are left with 171,477 bond-quarter observations for the primary analysis from 1998 to 2008 with non-missing independent variables.

Our primary dependent variable is the concentration ratio of institutional bond holdings, which is defined as the squared sum of the bond holding by each institution recorded in eMAXX divided by the total amount outstanding of that bond. We name this variable *Holding Concentration*. We also construct the institutional holding concentration ratio for short-term investors only, which is the squared sum of the bond holding by each short-term institutional investor divided by the total amount of holding by short-term institutional investors for each bond. We name this variable the *Short-term Concentration*. Short-term institutional investors include open-end and variable annuity funds, hedge funds, and investment managers. The third set of holding-based measures that we use in the robustness test includes the holdings by short-term (long-term) institutional investors. These measures are the ratios of holdings by short-term (long-term) investors divided by the total amount outstanding for each bond. We name these measures *Short-term Holdings* (*Long-term Holdings*).

To understand the dynamics of bond holding, we construct a dummy variable D_{age} that equals one if the bond is more than two years old and zero otherwise. In the robustness checks, we employ alternative measures of bond seasoning, including $D1_{age}$, a dummy variable that equals one if the bond is greater than two years but less than five years old and zero otherwise; $D2_{age}$, a dummy variable that equals one if the bond is more than five years old and zero otherwise; and *Age,* the natural logarithm of the age of the bond measured in months.

To capture whether the learning is about information, we construct four proxies for difficulty in learning. The first proxy is the rating dispersion measure, which is defined as the standard deviation of credit ratings across the three major credit rating agencies (Standard & Poor's, Moody's and Fitch).[7] We name this variable *DiffLearn1*. The second proxy, *DiffLearn2*, is a dummy variable that equals one if the bond is the first issue of the firm and zero otherwise. This proxy attempts to capture the fact that the level of learning difficulty is particularly high for bonds that are first-time issuances. Because there is no prior information about the default risk of the firm, the information acquisition as the bond seasons is particularly relevant. The third proxy, *DiffLearn3*, is a dummy variable that equals one if the bond belongs to a firm that is in the bottom 30th percentile of all firms in terms of the number of bonds outstanding during the same period and zero otherwise. This proxy captures the fact that if a firm has fewer bonds outstanding, bond investors may know less from the outset. Hence, the learning difficulty may be more intense for this type of bond. The fourth proxy, *DiffLearn4*, is a dummy variable that equals one if the bond belongs to a firm that is in the bottom 30th percentile of all firms in terms of the total dollar amount of bonds outstanding and zero otherwise. If the firm has fewer outstanding bonds in terms of amount, bond investors may know still less about newly issued bonds.

The control variables include standard bond characteristics. *Rating* takes numerical values from 1 for a credit rating of AAA to 21 for a credit rating of C.[8] *Coupon* is the coupon rate of the bond expressed in percentage terms. *Security* is a categorical variable that equals 1 for a senior secured bond, 2 for a senior bond, 3 for a senior subordinated bond, 4 for a junior bond, 5 for a junior subordinated bond, 6 for a subordinated bond and 7 otherwise. *Size* is the natural logarithm

[7] If the bonds are only rated by two rating agencies, we simply compute the rating difference between the two agencies. When the bond is only rated by one of the three rating agencies, the rating dispersion measure of the bond is zero.
[8] Specifically, we perform the following mapping between the letter grades and the numerical value. Using the S&P and Fitch rating categories, we assign a value of 1 to a credit rating of AAA, 2 to a credit rating of AA+, 3 to a credit rating of AA, 4 to a credit rating of AA-, 5 to 7 to a credit rating of A+, A and A-, respectively, 8 to 10 to a credit rating of BBB+, BBB, and BBB-, respectively, 11 to 13 to a credit rating of BB+, BB, and BB-, respectively, 14 to 16 to a credit rating of B+, B, and B-, respectively, 17 to 19 to a credit rating of CCC+, CCC, and CCC-, respectively, 20 to a credit rating of CC, and 21 to a credit rating of C.

of the total dollar amount outstanding of the bond in thousands. *Maturity* is the natural logarithm of the number of months until bond maturity. *Covenant* is the covenant index constructed following the procedure in Billett, King and Mauer (2007). $D_{covenant}$ is a dummy variable that equals one if the covenant index is greater than zero and zero otherwise.

To control for the liquidity effect, we construct three different bond liquidity measures with a monthly frequency. *AMH* is the Amihud liquidity measure, which is constructed following Lin, Wang and Wu (2011).[9] *Volume* is the natural logarithm of the total trading volume within a month as defined by Dick-Nielsen, Feldhütter and Lando (2012). *Roll* is Roll's liquidity measure constructed following Bao, Pan and Wang (2011) and Dick-Nielsen, Feldhütter and Lando (2012). Specifically, Bao, Pan and Wang (2011) define Roll's illiquidity measure in the bond market by taking the negative covariance of consecutive price changes calculated with daily data. We take the monthly average of all the daily Roll's measures for each bond. To proxy for the expected return of the bonds at the end of the quarter, we use the realized excess return in the following month net of the risk-free rate (e.g., Fama and French, 1993).

Table 1 reports summary statistics for these variables. Panel A reports the statistical distribution of these variables. The median *Holding Concentration* is 0.218, i.e., 21.8%. This concentration is slightly lower than the median ownership concentration of equities after the IPO, which is approximately 34% using data from 34 countries (Foley and Greenwood, 2009). The median excess expected return is approximately 10 bps per month. The average *Short-term Concentration* is 0.113, and the average *Short-term Holdings* is 1.7%. The median rating dispersion, *DiffLearn1* is 0.816. The average of *DiffLearn2*, *DiffLearn3*, and *DiffLearn4* are 0.143,

[9] Specifically, the Amihud measure for each bond is defined as the monthly average of a daily ratio, which is the absolute return of each bond on a day divided by the trading volume of the bond on that day within the month.

0.087 and 0.126, respectively, and the thresholds of these measures are computed at the firm level. More than 82.7% of bonds in our sample are more than two years old, and more than 51.6% are more than five years old. The average bond in our sample has a rating between A and A- with a coupon rate of 7.1%, senior subordinated, with more than four years to maturity. More than 38.6% of the bonds in our sample have covenant information. These measures are largely consistent with prior studies (e.g., Billett, King and Mauer, 2007; Bao, Pan and Wang, 2011), although our sample covers a slightly different time period –i.e., from 1998 to 2007. For example, Bao, Pan and Wang (2011) report that their final data sample based on TRACE from 2003 to 2009 has a median rating of A, an average maturity of six years and is four years old, on average. Billet, King and Mauer (2007) find that among 23,612 debt issues from 1960 to 2003 recorded in FISD, approximately 51% of the issues have covenant information.

[Insert Table 1 about here]

Panel B in Table 1 presents the correlation coefficients of these variables. Most of the dependent variables are significantly correlated with bond characteristics. For example, ownership concentration is negatively associated with bond rating and maturity. These results show that it is important to control for these bond characteristics when we investigate the life-cycle patterns for the institutional holdings of bonds.

Panel C in Table 1 presents the average of the holding concentration by age groups. From the left column of the panel, we first notice that ownership concentration does not mechanically diffuse over time. If anything, ownership concentration may appear static—the degree of concentration only slightly increases in the first one or two years of time, and then stabilizes in the following years. A further look at bond concentration among different types of investors, however, depicts a very different story. Interestingly, we see from the middle and right columns of the panel that ownership concentration among short-term investors in general *declines* over time—especially during the first a few years after the issuance of a bond—whereas the degree of concentration among long-term investors *increases* over the same period of time. Such opposite trends among the two different groups of investors strongly suggest that bond ownership may not be as static as it may first appear, and that clientele may play a pivotal role in affecting the dynamics of bond ownership as well as other characteristics of the bond market. Our next section takes on the task of examining in greater details the dynamics of bond ownership concentration.

4. The Dynamics of Bond Ownership

In this section, we examine the dynamics of corporate bond ownership and test the two competing hypotheses. We first investigate how bond concentration changes as the bond seasons. Second, we introduce four proxies of learning difficulty to test *Corollary 1*. We then provide a set of robustness checks to verify that the learning channel is unaffected by other known bond characteristics such as rating and maturity. Finally, we link bond seasoning to the linguistic ambiguity of credit rating reports to test the predictions of the two competing hypotheses as specified in *Corollary 2*.

4.1. Bond Seasoning and Ownership Concentration

We begin by investigating the link between institutional holding concentration and bond seasoning. We estimate a panel specification in which we regress *Holding Concentration* on the seasoning of the bonds using quarterly data from 1998Q1 to 2007Q2 with firm and year fixed effects and cluster the standard errors by firm and year. The variables are defined in the previous section.

We report the results in Table 2. Models 1 to 3 employ the dummy variable D_{age}, Models 4 to 6 employ the two dummy variables, $D1_{age}$ and $D2_{age}$, and Models 7 to 9 employ the continuous seasoning variable, *age*. For each seasoning variable, we employ three different sets of liquidity measures, *AMH*, *Volume* and *Roll*.

[Insert Table 2 about here]

We find a consistently significant negative relation between *Holding Concentration* and the various proxies for the seasoning of the bonds across all nine models in Table 2. When the bond becomes older than two years (i.e., when D_{age} takes the value of one), the concentration of institutional holdings shrinks by an amount that ranges from 2.56% in Model 1 to 2.23% in Model 3 in absolute magnitude. In Models 4 to 6, the ownership concentration declines by 1.88% to 2.35% in absolute magnitude when the bond becomes two years old (i.e., when $D1_{age}$ takes on the value of 1), and it further declines by another 4.03% to 4.22% when the bond becomes five years old (i.e., $D2_{age}$ takes on the value of 1). If we add together these two seasoning effects (i.e., $D1_{age}$ and $D2_{age}$), we can quantify the impact on ownership concentration as greater than 6% in absolute magnitude. This impact amounts to more than 16.7% reduction in ownership concentration with respect to its standard deviation (the standard deviation is 35.9% from Table 1), or 15% with respect to its average (the average is 38.4%), or 27.5% with respect to its median value (the median value is 21.8%). Models 7 to 9 employ the continuous variable of seasoning and confirm the negative relation between seasoning and concentration. The negative impacts are statistically significant at the 1% significance level and economically sizable across all the specifications. These results show that there is a consistent reduction of institutional holding concentration as the bond seasons. To the best our knowledge, this is the first time that the life-cycle dynamics of bond ownership have been clearly documented.

It is notable that there is a strong negative relation between concentration and the covenant dummy and a positive relation between concentration and the covenant index. This result suggests that concentration is in general associated with a lack of covenants. This finding is intuitive: more dispersed ownership is related to bonds protected by restrictive covenants. However, once the bond covenant is in place, too many covenants will in fact reduce the spectrum of investors who are willing to hold them because covenants increase the interest of – and the concentrated holdings of – investors with lower bargaining power for resolving conflicts by reducing stockholder-bondholder conflict over the exercise of growth options (e.g., Billett, King and Mauer, 2007). Thus, bonds with many covenants may be preferred by this special group of vulnerable investors.

Additionally, rating does not appear to be related to concentration in a significant way. This result is likely because we employ firm and time fixed effects. By contrast, maturity is positively related to concentration. It is expected that higher maturity is related to higher risk for the investor. Overall, these results provide some preliminary support for the *learning hypothesis*.

4.2. Seasoning and Learning Difficulty

Next, to further confirm that the underlying reason for the negative relation between holding concentration and the seasoning of the bond is related to increased learning of underlying information, we explore how the aforementioned results vary across bonds with different degrees of "learning difficulty". According to *Corollary 1*, our four measures of learning difficulty should reduce the speed of ownership dilution under the *learning hypothesis* and enhance the speed of ownership concentration under the *asymmetric information hypothesis*. Thus, to further differentiate between the two competing hypotheses, we interact bond seasoning with learning difficulty proxies and examine whether this interaction reduces or reinforces the speed of ownership dilution.

We report the results in Table 3. Models 1 to 3 in Table 3 examine the impact of *DiffLearn1* on learning while controlling for three different liquidity measures — the Amihud liquidity measure, trading volume, and Roll's liquidity measure, respectively. In all three specifications, the coefficient of the interaction term D_{age}×*DiffLearn1* is significantly positive at the 1% significance level, ranging from 0.0027 to 0.0028. This result represents a reduction of the learning effect by 1.48% to 1.53% for a one-standard deviation increase in *DiffLearn1*. The reduction amounts to between 47% and 54% of the overall learning effect.[10] These numbers show that learning is slower for bonds that have more highly dispersed credit ratings among the three major rating agencies, which is consistent with the *learning hypothesis*.[11]

[Insert Table 3 about here]

Models 4 to 12 in Table 3 employ the other three learning proxies, *DiffLearn2*, *DiffLearn3* and *DiffLearn4*, and show consistent results. Specifically, Models 4 to 6 report the results for the *DiffLearn2* variable. The coefficients of the interaction terms capture a reduction of learning ranging from 2.00% in Model 4 to 2.48% in Model 6. This proxy of learning difficulty, therefore, slows down the reduction of concentration as the bond seasons by 79% to 111% (compared with the learning effect, which according to the coefficient of D_{age} is approximately 2.52% in Model 4 to 2.23% in Model 6). Likewise, the interaction term is not only statistically significant but also economically sizable when we employ the third and fourth proxies (i.e., *DiffLearn3* and *DiffLearn4* in Models 7 to 9 and Models 10 to 12, respectively).

All four proxies for learning difficulty provide consistent results that the reduction of ownership concentration is slowed down for bonds about which it is more difficult to acquire new

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[10] The magnitude is calculated by multiplying the coefficient of the interaction term (0.0027 and 0.0028) with the standard deviation of *DiffLearn1* (which is at 5.493 in Table 1), scaled by the coefficient of D_{age}. Hence, the impact is computed as $0.0027 \times 5.493 \,/\, 3.15\% \;=\; 47\%$ for Model 1 and $0.0028 \times 5.493/2.85\% \;=\; 54\%$ for Model 3.

[11] To ensure that learning difficulty concentrates on bonds rather than on firms, we have also conducted robustness checks in which we further control for firm-level credit report dispersion as well as its interaction with bond seasoning. Our results are robust to these additional controls, which is perhaps not surprising as firm-fixed effects are already controlled for in all our main tests.

information. Note that the results of the last three proxies also further address the concern that our results may be driven by a mechanical diffusion of bond ownership over time. If some sort of mechanical arrangement is in place, for instance between a firm and its connected bond investors, it should more or less work in the same way for all bonds issued by a same firm. By contrast, the seasoning impact on bond concentration differs in earlier and later issuance of bonds even when firm-fixed effects are controlled. Overall, these results provide empirical support for the *learning hypothesis* as opposed to alternative hypothesis and mechanisms.

Next, we provide a set of robustness checks to eliminate alternative explanations. First, we include the interaction between bond seasoning and credit ratings to control for the possibility that the difficulty in learning merely proxies for different levels of credit risk. Second, we verify that the results are not caused by the maturity of the bonds. Third, we control for other possible omitted variables.

We report the results in Table 4. In the interest of brevity, we do not report the coefficients of the control variables, but they are available upon request. The results in Panel A in Table 4 are similar to those in the baseline case (Table 3) after we further control for the interactions between bond seasoning and the credit ratings of each bond. This robustness check is important because credit quality is identified as a key factor in determining bond returns (e.g., Greenwood and Hanson, 2013) that may subsequently affect ownership concentration. Our results confirm that the learning channel differs from that of credit quality. Specifically, Models 1 to 3 in Panel A show that the coefficient of D_{age} remains significantly negative, whereas the coefficient of the interaction term $D_{age}\times DiffLearn1$ remains significantly positive at the 1% significance level. Models 4 to 12 yield similar results when *DiffLearn2*, *DiffLearn3*, and *DiffLearn4* are employed. Although the coefficients of the interaction term are slightly smaller than the baseline results in terms of economic and statistical significance, our main result is robust. Notably, we also find that the coefficients of the credit rating and the interaction of the rating and the seasoning dummy are statistically significant at the 1% significance level. Therefore, going forward, we include this interaction term as an additional control variable. Overall, these results suggest that learning is not spuriously correlated with the credit risk of bonds.

[Insert Table 4 about here]

Panel B in Table 4 shows that our main result – that there is a negative relation between seasoning and concentration – is not an artifact of the positive relation between seasoning and maturity. Prior studies show that debt maturity is an important determinant of the price of bonds (e.g., Black and Scholes, 1973; Black and Cox, 1976). In the recent literature, some studies have shown that the rollover risk of maturing debt can be significantly affected by the default and liquidity risk of the bonds (e.g., He and Xiong, 2012). These findings suggest that it is important to exclude the possibility that the negative seasoning effect on concentration is simply a manifestation of the positive concentration-maturity effect – i.e., as a bond approaches its maturity, less learning will occur. We therefore test whether the seasoning effect on concentration disappears in the presence of the maturity effect. To perform this test, we include the interaction terms between the four difficulty proxies and the *maturity* variable. Panel B shows that across all 12 models, the coefficient of bond seasoning remains significantly negative at the 1% significance level. Moreover, the coefficients of the interaction terms ($D_{age} \times DiffLearn$) remain significantly positive in Models 1 to 3 and Models 7 to 12 at the 10% significance level. The economic magnitude of these coefficients is slightly less than the coefficients described above, which suggests that the maturity effect slightly overlaps with the seasoning effect. Overall, however, the negative concentration-age relation is robust after controlling for bond maturity.

Third, as an additional robustness check to control for other potentially omitted variables, we interact our seasoning variables with *all* the control variables. Panel C in Table 4 presents the results. Across all 12 models, we find that bond seasoning and concentration remain significantly negatively correlated and that the four proxies for learning difficulty still reduce the seasoning effect. All the coefficients are statistically significant at the 5% significance level. These results are consistent with the baseline results documented earlier.

Overall, these findings show that the negative relation between concentration and bond seasoning is reduced for these bonds as learning difficulty increases. This result provides further support for the *learning hypothesis* because the *asymmetric information hypothesis* would predict the opposite results.

5. What Do Investors Learn?

The two alternative hypotheses of learning or asymmetric information also have different implications for information ambiguity under *Corollary 2*. To test these implications, we perform three steps of analysis regarding the content of learning.

In the first step, we construct two direct measures of "information ambiguity" based on the credit rating reports produced by Standard and Poor's during credit rating change announcements. These reports are released when S&P announced its rating actions. The first measure of information ambiguity at the industry/macro level is the interaction between the following two variables: 1) ambiguity in tones, measured as the minimum of the positive or negative tone in each credit rating report—the minimum of the positive or negative tone according to Loughran and McDonald (2011) represents the amount of "ambiguous information" at the word-level in each report; and 2) the proportion of sentences that fall into the categories of "macroeconomics" and "industry". We follow Agarwal, Chen and Zhang (2015) to use the Naïve Bayesian algorithm to identify the categorization of each sentence. The industry/macro information categories are important to bond holders because credit events and adverse price movements of bonds can be easily triggered by certain industry/macro conditions.

Learning in this content has an explicit interpretation that the market gradually understands the potential impact of the industry/macro situation on the value of existing corporate bonds (i.e., the macro and industrial exposure of credit risk). If so, the degree of ambiguity concerning industry/macro could be in general reduced over the seasoning of corporate bonds. By contrast, learning about cash flow news (finance/accounting) should be relatively limited, as the equity market typically focuses on such information. We are therefore most interested in the degree of ambiguity as embedded in the description of industry/macro information in a firm's credit report, while resorting to cash flow ambiguity as a proxy for Placebo tests.

The second measure of information ambiguity comes from the interaction of the FOG index measure of the credit rating report and the proportion of sentences that fall into industry/macro or finance/accounting category. FOG index is developed by Gunning (1952) that defines the readability of an article. The FOG index is defined as $0.4\left[\left(\frac{words}{sentences}\right)+100\left(\frac{complex\ words}{words}\right)\right]$. The complex words are defined as those words that have three or more syllables (excluding the common suffixes as a syllable). Similar to the first measure, this measure also captures the amount of "ambiguous information" in macro/industry information categories. Table 5 reports the results by employing the two information ambiguity measures in Panel A and Panel B respectively. The standard errors are clustered by year and firm.

[Insert Table 5 about here]

Panel A in Table 5 shows that the coefficients of three types of seasoning variables (i.e., D_{age}, $D1_{age}$ and $D2_{age}$, and *age*) are all significantly negatively related to the first ambiguity measure. The statistical significance is at the 10% significance level in the nine model specifications. Model 1, 4 and 7 employ the liquidity measure *AMH*, Model 2, 5 and 8 use the liquidity measure of *Volume*, and Model 3, 6 and 9 use the liquidity measure *Roll*. The negative coefficient suggests that the information ambiguity about the average bond indeed declines as the bond seasons. The effect is not only statistically significant but also economically relevant. Seasoned bonds, as measured by D_{age} (or $D1_{age}$ and $D2_{age}$), demonstrate a drop of 2.51% for industry/macro related information ambiguity (e.g, the coefficient on D_{age} in Model 2), which amount to a reduction of 14% in the degree of ambiguity with respect to its sample mean (which is at 0.1773). These results show that when a bond becomes more seasoned, the credit rating reports from S&P have less ambiguous information about the firm's industry and macroeconomic credit-related information. Hence, our results suggest that learning reduces the ambiguous credit-related information at the industrial and macroeconomic environment of the firm and its underlying bonds.

Panels B further confirms that the usage of complexity words related to industry and macroeconomics information is reduced as the bond seasons. The economic magnitude of the impact is at par with what we observe in Panel A. For instance, the reduction of the information ambiguity in Model 2 of Panel B is about 12% (as the coefficient on D_{age} is at -0.2241) with respect to the sample mean (which is at 1.8158).

We also verify that the degree of ambiguity regarding the cash flow news of a firm gets reduced over bond seasoning. For the interest of space, we do not tabulate these insignificant results. It is, however, worthwhile to point out that this insignificant relationship is reasonable, as the equity market provides perhaps a more effective way to learn about cash flow information, and confirms that our test has the proper power to reject any content of information unrelated to learning.

In the second step of analysis, we introduce two dummy variables that reflect the big change in the term structure of interest rate in the economy. The dummy variable $TSCS_1$ equals to one if the absolute change in the monthly credit spread between the 20-year Constant Treasury yield and the 1-year Constant Treasury yield is in the top 50 percentile during the sample period, and zero otherwise. The dummy variable $TSCS_2$ equals to one if the absolute change in the monthly credit spread between the 20-year Constant Treasury yield and the 5-year Constant Treasury yield is in the top 50 percentile during the sample period, and zero otherwise. Both dummy variables capture the extreme change in the term structure of credit risk in the economy. We then link the two dummy variables to the two information ambiguity measures by interacting these term-structure variables with the bond "seasoning" variables. Table 6 reports the new results.

[Insert Table 6 about here]

Panel A and Panel B in Table 6 repeat the Panel A and Panel B in Table 5 by including the dummy variable $TSCS_1$. Panel C and Panel D in Table 6 repeat the Panel A and Panel B in Table 5 by including the dummy variable $TSCS_2$. The coefficients on the interaction of the "seasoning" variables (D_{age}, $D1_{age}$ and $D2_{age}$) and the dummy variables $TSCS_1$ and $TSCS_2$ are positively and statistically significant at the 10% significance level in all four panels. These results show that the reduction of the information ambiguity as bonds season has slowed down during the period of large shift in the state variable of term structure (i.e., when $TSCS_1$ and $TSCS_2$ equal to one respectively).

In our last step of analysis, we estimate how ownership concentration as explored in Table 2 can be affected by the interaction between the two dummy variables of large term-structure changes and bond seasoning. The results are reported in Table 7. Model 1, 4 and 7 employ the liquidity measure *AMH*, Model 2, 5 and 8 use the liquidity measure of *Volume*, and Model 3, 6 and 9 use the liquidity measure *Roll*.

[Insert Table 7 about here]

Panel A in Table 7 shows that the coefficient on the interaction terms is statistically and significantly positive at the 10% significance level in eight out of the nine models. This result indicates that, consistent with the slowing down in learning efficiency, the seasoning effect of *Holding Concentration* also slows down when the economy experiences drastic term structure shocks. This results further confirms the link between learning and the reduction in *Holding Concentration*. On average, the learning effect slows down by about 25%. Panel B in Table 7 shows stronger results as the coefficient on the interaction term is significantly positive at the 1% level across all nine models. The learning effect slows down by about 30% to 50% in the period of volatile credit risk. These result indicate that the learnt information is related to the dynamic macro exposure of credit risk in the economy.

Thus far, we have illustrated that bond ownership in general becomes more diffused when bonds season, potentially because learning allows less informed investors to participate. Using information from the credit rating reports, we 1) narrow down the source of the learnt information to the macro exposure of firms' credit risk; 2) demonstrate that efficiency of learning is subject to large shocks in the state variable of term structure of interest rate; and 3) document that the seasoning pattern of bond ownership concentration exhibits a similar pattern. All the three test results provide support for *learning hypothesis*. Our remaining task is to examine whether the learning hypothesis is also consistent with the pricing and liquidity conditions of bonds as observed in the market.

6. Asset Pricing Implications of Seasoning

We now focus on *Corollary 3* and *Corollary 4*. We examine how the bond ownership clientele changes as the bond seasons and explore the impact of bond seasoning on bond liquidity and bond returns.

6.1. Investor Clientele and Learning

We begin by investigating whether the negative seasoning effect on ownership concentration is related to a change in the clientele of bond investors. The literature has shown that short-term investors are better informed than long-term investors and, as a result, that their trading activities are more sensitive to learning relevant information (e.g., Yan and Zhang, 2009). This type of active acquisition of new information predicts that our earlier findings should be concentrated among short-term investors. We therefore investigate whether seasoning affects short-term and long-term investors differently. According to *Corollary 3*, bond ownership spreads from short-term investors to long-term investors under the *learning hypothesis,* which effectively reduces the ownership concentration of short-term investors. By contrast, the alternative hypothesis predicts that bond ownership concentrates even more in the hands of more informed short-term investors.

We begin by testing the relation between the concentration of short-term investors and bond seasoning. Short-term investors include finance companies, hedge funds, investment managers and mutual funds. Long-term investors include the remaining institutional investors (i.e., pension funds and insurance companies). We report the results in Table 8.

[Insert Table 8 about here]

The results support the *learning hypothesis*. We find that in Models 1 to 3 in Panel A in Table 8 the concentration of short-term investors is negatively related to D_{age} at the 1% significance level.

Moreover, the coefficients of the interaction of D_{age} and the four information proxies are positive at the 1% significance level. These results suggest that short-term investor concentration is significantly reduced by learning. When a bond seasons, its ownership becomes less concentrated in more informed short-term investors. Specifically, the seasoning effect leads to a reduction of concentration in short-term investors by 2.65% to 2.81%.

In Panel B in Table 8, we find a similar pattern when we replace short-term investors' concentration with the fraction of their holdings with respect to total institutional ownership in terms of asset value. The dependent variable is *Short-term Holding*, as defined in Table 1. Specifically, the coefficients of D_{age} in Models 1 to 12 are all significantly negative at the 1% significance level. The coefficients of the interaction of D_{age} and *DiffLearn2*, *DiffLearn3* and *DiffLearn4* are all significantly positive at the 10% significance level in Models 4 to 12. These results not only further support our previous findings regarding the seasoning effect on institutional holding concentration but also suggest that ownership changes from more-informed short-term investors to less-informed long-term investors.

In Panel C in Table 8, we replace short-term investors' holding with long-term investors' holding (i.e., the variable *Long-term Holding* that is defined in Table 1), and we find consistent results: long-term investors' ownership increases with bond seasoning. The coefficients of D_{age} in Models 1 to 12 are all positive at the 1% significance level. The coefficients of the interaction of D_{age} and *DiffLearn2*, *DiffLearn3* and *DiffLearn4* are all negative at the 10% significance level in Models 4 to 12. These results show that the level of the institutional holdings by long-term investors increases as the bond seasons. This increase is moderated by learning difficulty, consistent with our earlier findings. Hence, the learning effect impacts not only investor concentration but also investor clientele, in the manner predicted by the *learning hypothesis*.

6.2. Liquidity and Bond Returns

As the last step of our analysis, we test *Corollary 4*. We recall that, according to the *learning hypothesis*, bond liquidity and return should decrease with seasoning in the presence of more long-term investors. We test this corollary by examining how liquidity and return are affected by the interaction between bond seasoning and the fraction of ownership based on long-term investors. We use the same set of three liquidity proxies for the dependent variables as above: *AMH*, *Volume* and *Roll* measures. We also control for the one-month lagged liquidity measures. The results are reported in Table 9.

[Insert Table 9 about here]

We have several findings. First, when used alone, bond seasoning (D_{age}) reduces the trading volume of a bond (*Volume*) in Model 3 and increases Roll's illiquidity measure in Model 5 at the 5% significance level. These results suggest that liquidity is reduced as a bond seasons. As discussed above, both the *learning hypothesis* and the *asymmetric information hypothesis* predict this pattern.

More importantly, we rely on *Corollary 4* to use the interaction between bond seasoning and long-term institutional holdings to differentiate the two hypotheses. The impact of the interaction term is reported in Models 2, 4 and 6 in Table 9. We find that bonds with more long-term investors are related to less trading volume and higher Roll's illiquidity in Models 4 and 6. These results are significant at the 1% and 10% significance levels, respectively and suggest that the reduction of trading activity is more pronounced for those bonds that are held by more long-term investors, which supports the *Learning Hypothesis* as opposed to the *Asymmetric Information Hypothesis*. Although the Amihud measure does not change much with bond seasoning or bond ownership, this result is not surprising because it describes the price impact of trading rather than the effects of pure trading volume.

Finally, we focus on bond returns. To proxy for the expected returns of the bond, we follow Fama and French (1993) and use the next month's realized return net of the risk-free rate of the same maturity.[12] Then, we regress the returns against the interaction between bond seasoning and the ownership of long-term investors and report the results in Table 10.

[Insert Table 10 about here]

When used alone, bond seasoning (D_{age}) reduces the bond expected return in Models 1, 3 and 5, although the coefficients are not statistically significant at the 10% significance level. More importantly, the interaction term between bond seasoning and the ownership of long-term investors significantly reduces bond returns, as reported in Models 2, 4, and 6. The reduction of returns over bond seasoning is approximately 11 bps for a one-standard deviation increase in long-term institutional holdings. This reduction is consistent with the conjecture that information risk is reduced as the bond seasons from the perspectives of less informed long-term investors, which again supports the *learning hypothesis*.

Overall, our results document that the ownership concentration of corporate bonds drops as the bond seasons. This reduction is most plausibly due to the market learning information about the bond. The ownership of the bonds shifts from short-term investors to long-term investors, who are less informed and less willing to trade in comparison. Hence, both the bond return and its liquidity decline as the bond seasons. These results suggest that the information environment is pivotal for

[12] The literature has not explicitly discussed various proxies for the expected returns of the bonds. Most of the prior literature has employed yield to maturity as a proxy for expected returns. Our results are similar when using the yield to maturity. These additional results can be supplied upon request.

the corporate bond market and can result in a significant clientele effect during the life-cycle of bonds as they season.

7. Conclusion

In this study, we explore the dynamics of corporate bond ownership. For the first time in the literature, to the best of our knowledge, we document that ownership concentration declines as a bond seasons. Although this pattern is similar to the findings in the equity literature whereby the equity ownership concentration declines after an IPO, the economic mechanism behind it is different. We find that learning by the market is the primary driving force behind the decline in concentration.

We provide evidence that consistently supports the *learning hypothesis*. First, we demonstrate that the speed of ownership evolution significantly reduces as learning difficulty increases. Moreover, learning also appears to resolve information ambiguity related to credit-risk at the macro/industry levels as presented in the credit rating reports for corporate bonds. Finally, the learning effect allows bond ownership to be transferred from more informed short-term investors to less informed long-term investors. This shift adversely affects bond liquidity and bond returns, particularly when there is high long-term investor ownership.

Our paper reveals that the information diffusion process in the corporate bond market plays an important role in the investment decisions of institutional investors. An appropriate policy direction for consideration would then be a deliberate effort to improve the information environment in the bond market. The announcement by the Financial Industry Regulatory Authority (FINRA) to propose stricter rules that require electronic bond trading venues to supply more information about the bond price quotes on 19 September 2014 is the encouraging policy movement.

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Table 1. Summary Statistics and Correlation Matrix

This table presents the summary statistics and correlation matrix for our main variables. The bond data sample spans from 1998Q1 to 2007Q2. *Holding Concentration* is the squared ratio of the average of the percentage holding by each institution divided by the total institutional holding of a particular bond. Institutional holding is the total amount of institutional ownership recorded in the Emaxx database divided by the outstanding amount of the bond issue in Mergent FISD. $Return_e$ is the expected return of the bond at the current quarter end, which is proxied by the realized return in the next month minus the risk-free rate from NAIC and TRACE. *Short-term Concentration* is the squared concentration ratio by short-term investors only. *Short-term Holdings* is the ratio of short-term investors divided by the total institutional holdings recorded in Emaxx. Short-term investors include holdings by annuities/variable annuities, finance companies, hedge funds, investment managers and mutual funds. *Long-term Holdings* is the ratio of long-term investors (the remaining institutional investors) divided by the total institutional holdings recorded in Emaxx. *DiffLearn1* is the credit rating dispersion among the three major credit rating agencies, Moody's, Standard & Poor's, and Fitch, and is computed as the standard deviation of the credit ratings from the three rating agencies. The credit ratings are converted into a categorical scale from 1 to 21 for the ratings AAA to C equivalent. If one of the three agencies' ratings is not available, we use the difference between the remaining two ratings. The rating data are obtained from Mergent FISD. *DiffLearn2* is a dummy variable that equals one if the bond is the first issue of the firm and zero otherwise. *DiffLearn3* is a dummy variable that equals one if the bond belongs to a firm that is in the bottom 30^{th} percentile of all firms in terms of the number of bonds outstanding and zero otherwise. *DiffLearn4* is a dummy variable that equals one if the bond belongs to a firm that is in the bottom 30^{th} percentile of all firms in terms of the total dollar outstanding amount of bonds and zero otherwise. D_{age} is a dummy variable that equals one if the bond is more than two years old and zero otherwise. $D1_{age}$ is a dummy variable that equals one if the bond is more than two and less than five years old and zero otherwise. $D2_{age}$ is a dummy variable that equals one if the bond is more than five years old and zero otherwise. *Age* is the natural logarithm of the age of the bond. *Rating* is the numerical scale of the credit ratings, ranging from 1 to 21. *Coupon* is the coupon rate of the bond in percentage. *Security* is a categorical variable that equals one if it is a senior secured bond, two if it is a senior bond, three if it is a senior subordinated bond, four if it is a junior bond, five if it is a junior subordinated bond, six if it is a subordinated bond and seven otherwise. *Size* is the natural logarithm of the total amount outstanding of the bond in thousands. *Maturity* is the natural logarithm of the number of months to maturity of the bond. *Covenant* is the covenant index constructed by following Billett, King and Mauer (2007). $D_{covenant}$ is a dummy variable that equals one if any of the covenant indexes is not zero. *AMH* is the Amihud liquidity measure, which is constructed following Lin, Wang and Wu (2011). *Volume* is the natural logarithm of the total trading volume. *Roll* is Roll's liquidity measure constructed following Bao, Pan and Wang (2011). We report the summary statistics in Panel A and the correlation matrix in Panel B. Panel C reports the distribution of overall holding concentration, concentration by short-term investors, and concentration by long-term investors by ten age groups. The p-values are reported in italics. ***, **, and * represent statistical significance at 1%, 5% and 10%, respectively.

Panel A: Summary Statistics

	N	Mean	p1	p5	p25	p50	p75	p95	p99	Std
Dependent Variables										
Holding Concentration	171,477	0.384	0.000	0.038	0.088	0.218	0.625	1.000	1.000	0.359
$Return_e$	61,814	0.002	-0.110	-0.053	-0.011	0.001	0.014	0.058	0.117	0.036
Short-term Concentration	149,489	0.113	0.000	0.000	0.000	0.000	0.110	0.684	1.000	0.227
Short-term Holdings	149,489	0.017	0.000	0.000	0.000	0.000	0.002	0.040	0.500	0.094
Long-term Holdings	149,489	0.869	0.000	0.110	0.873	0.990	1.000	1.000	1.000	0.255
Independent Variables										
DiffLearn1	171,477	2.850	0.000	0.000	0.000	0.816	1.414	17.146	21.229	5.493
DiffLearn2	171,477	0.143	0.000	0.000	0.000	0.000	0.000	1.000	1.000	0.351
DiffLearn3	171,477	0.087	0.000	0.000	0.000	0.000	0.000	1.000	1.000	0.282
DiffLearn4	171,477	0.126	0.000	0.000	0.000	0.000	0.000	1.000	1.000	0.332
D_{age}	171,477	0.827	0.000	0.000	1.000	1.000	1.000	1.000	1.000	0.379
$D1_{age}$	171,477	0.310	0.000	0.000	0.000	0.000	1.000	1.000	1.000	0.463
$D2_{age}$	171,477	0.516	0.000	0.000	0.000	1.000	1.000	1.000	1.000	0.500
Age	171,477	3.934	1.099	2.197	3.526	4.143	4.575	4.977	5.204	0.884
Rating	171,477	6.671	0.000	1.000	5.000	6.000	8.000	11.000	17.000	3.185
Coupon	171,477	7.100	3.600	5.264	6.450	7.000	7.750	9.300	10.250	1.234
Security	171,477	2.131	1.000	1.000	2.000	2.000	2.000	3.000	6.000	0.787
Size	171,477	3.841	0.000	0.693	2.303	4.198	5.298	6.310	7.313	1.833
Maturity	171,477	3.854	1.609	2.079	3.135	3.850	4.543	5.642	5.886	1.055
Covenant	171,477	0.099	0.000	0.000	0.000	0.000	0.200	0.333	0.533	0.143
$D_{covenant}$	171,477	0.386	0.000	0.000	0.000	0.000	1.000	1.000	1.000	0.487
AMH	66,816	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.065
Volume	68,373	14.704	9.210	10.820	13.528	14.951	16.118	17.733	18.860	2.076
Roll	35,693	2.574	0.000	0.000	0.509	1.335	2.898	8.712	21.138	4.833

Panel B: Correlation Matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
(1) Holding Concentration	1																	
	-																	
(2) $Return_e$	0.01***	1																
	0.00	-																
(3) Short-term Concentration	0.21***	0.00	1															
	0.00	0.41	-															
(4) Short-term Holdings	-0.07***	0.00	0.59***	1														
	0.00	0.83	0.00	-														
(5) DiffLearn1	0.03***	0.03***	-0.02***	-0.03***	1													
	0.00	0.00	0.00	0.00	-													
(6) DiffLearn2	-0.20***	0.00	-0.03***	0.03***	0.04***	1												
	0.00	0.73	0.00	0.00	0.00	-												
(7) DiffLearn3	-0.15***	0.01	-0.01**	0.06***	0.05***	0.52***	1											
	0.00	0.15	0.01	0.00	0.00	0.00	-											
(8) DiffLearn4	0.12***	0.01	0.01***	-0.02***	0.11***	0.22***	0.36***	1										
	0.00	0.16	0.00	0.00	0.00	0.00	0.00	-										
(9) D_{age}	0.06***	0.03***	-0.06***	-0.15***	0.04***	0.05***	0.01***	0.06***	1									
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-									
(10) Rating	-0.06***	0.03***	0.01***	0.14***	-0.00**	0.08***	0.08***	0.08***	0.05***	1								
	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	-								
(11) Coupon	0.03***	0.00	-0.00	-0.00	-0.04***	0.18***	0.10***	0.12***	0.31***	0.22***	1							
	0.00	0.31	0.91	0.14	0.00	0.00	0.00	0.00	0.00	0.00	-							
(12) Security	-0.18***	-0.00	-0.01***	0.03***	-0.06***	0.10***	0.13***	-0.07***	0.01**	-0.03***	0.02***	1						
	0.00	0.51	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	-						
(13) Size	-0.71***	-0.02***	-0.13***	0.13***	-0.08***	0.12***	0.09***	-0.27***	-0.15***	-0.02***	-0.15*	0.22***	1					
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-					
(14) Maturity	-0.10***	-0.01*	-0.07***	-0.05***	-0.10***	0.03***	0.01***	0.00	-0.06***	0.05***	0.19***	0.09***	0.08***	1				
	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.00	-				
(15) Covenant	-0.46***	-0.00	-0.08***	0.12***	-0.06***	0.19***	0.16***	-0.04***	0.06***	0.20***	0.19***	0.03***	0.48***	0.14***	1			
	0.00	0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-			
(16) $D_{covenant}$	-0.54***	-0.01**	-0.10***	0.08***	-0.08***	0.17***	0.13***	-0.07***	0.06***	0.13***	0.13***	0.13***	0.58***	0.15***	0.87*	1		
	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-		
(17) AMH	-0.00	0.01**	-0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	0.01	-0.00	0.00	0.01**	0.01	0.00	1	
	0.95	0.02	0.82	0.98	0.50	0.61	0.74	0.57	0.40	0.17	0.15	0.63	0.91	0.03	0.16	0.32	-	
(18) Volume	-0.53***	-0.02***	-0.10***	0.09***	-0.06***	0.06***	0.05***	-0.17***	-0.15***	0.01***	-0.13***	0.18***	0.60***	0.16***	0.36***	0.44***	-0.03***	1
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
(19) Roll	-0.15***	-0.00	-0.03***	0.03***	-0.02***	0.03***	0.02***	-0.04***	0.00	0.05***	0.03***	0.06***	0.16***	0.12***	0.14***	0.15***	0.00	0.27*
	0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.00

Panel C: The Distribution of Holding Concentration by Age Groups

Age Group	No.	Holding Concentration		Holding Concentration by Short-term Investors		Holding Concentration by Long-term Investors	
		Mean	STD	Mean	STD	Mean	STD
0-1 year	13,584	0.3113	0.3309	0.0290	0.1272	0.1275	0.2451
1-2 years	16,158	0.3612	0.3530	0.0269	0.1199	0.1585	0.2749
2-3 years	18,137	0.3873	0.3625	0.0210	0.1080	0.1888	0.2975
3-4 years	18,369	0.4032	0.3666	0.0182	0.1016	0.2052	0.3059
4-5 years	16,691	0.3994	0.3649	0.0151	0.0902	0.2046	0.3065
5-6 years	14,969	0.3842	0.3604	0.0128	0.0810	0.1966	0.3018
6-7 years	15,417	0.3854	0.3605	0.0110	0.0766	0.2032	0.3081
7-8 years	14,769	0.3910	0.3601	0.0094	0.0651	0.2049	0.3063
8-9 years	14,756	0.3968	0.3599	0.0108	0.0760	0.2104	0.3085
9-10 years	10,827	0.4081	0.3612	0.0098	0.0667	0.2167	0.3130
10-12 years	9,134	0.4023	0.3597	0.0135	0.0828	0.2083	0.3095
>12 years	8,666	0.3760	0.3414	0.0159	0.0861	0.1854	0.2851

Table 2. The Life-cycle of Institutional Holding Concentration

This table presents our baseline model, which describes the relation between institutional holding concentration and the seasoning of the corporate bonds. The bond data sample spans from 1998Q1 to 2007Q2. The dependent variables are *Holding Concentration* of institutional holdings, which is the squared ratio of the average of the percentage holding by each institution divided by the total institutional holding of a particular bond. D_{age} is a dummy variable that equals one if the bond is more than two years old and zero otherwise. $D1_{age}$ is a dummy variable that equals one if the bond is more than two but less than five years old and zero otherwise. $D2_{age}$ is a dummy variable that equals one if the bond is more than five years old and zero otherwise. *Age* is the natural logarithm of the age of the bond. *Rating* is the numerical scale of the credit ratings, ranging from 1 to 21. *Coupon* is the coupon rate of the bond as a percentage. *Security* is a categorical variable that equals one if it is a senior secured bond, two if it is a senior bond, three if it is a senior subordinated bond, four if it is a junior bond, five if it is a junior subordinated bond, six if it is a subordinated bond and seven otherwise. *Size* is the natural logarithm of the total amount outstanding of the bond divided by 1,000. *Maturity* is the natural logarithm of the number of months to maturity of the bond. *Covenant* is the covenant index constructed by following Billett, King and Mauer (2007). $D_{covenant}$ is a dummy variable that equals one if any of the covenant index is not zero. *AMH* is the Amihud liquidity measure, which is constructed following Lin, Wang and Wu (2011). *AMH_missing* is a dummy variable that equals one if AMH is missing and zero otherwise. *Volume* is the natural logarithm of the total trading volume. *Volume_missing* is a dummy variable that equals one if *Volume* is missing and zero otherwise. *Roll* is Roll's liquidity measure constructed following Bao, Pan and Wang (2011). *Roll_missing* is a dummy variable that equals one if *Roll* is missing and zero otherwise. The t-statistics are reported in brackets. The standard errors are clustered by year and firm. ***, **, and * represent statistical significance at 1%, 5% and 10%, respectively.

	Dependent Variable: Holding Concentration								
VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
D_{age}	-0.0256***	-0.0266***	-0.0223***						
	(-4.85)	(-4.97)	(-4.11)						
$D1_{age}$				-0.0224***	-0.0235***	-0.0188***			
				(-4.58)	(-4.72)	(-3.73)			
$D2_{age}$				-0.0415***	-0.0422***	-0.0403***			
				(-4.92)	(-4.96)	(-4.60)			
Age							-0.0209***	-0.0217***	-0.0196***
							(-5.42)	(-5.51)	(-4.88)
Rating	-0.0022	-0.0021	-0.0024	-0.0022	-0.0021	-0.0023	-0.0023	-0.0022	-0.0024
	(-1.33)	(-1.28)	(-1.41)	(-1.31)	(-1.25)	(-1.38)	(-1.32)	(-1.27)	(-1.40)
Coupon	-0.0030	-0.0029	-0.0020	-0.0004	-0.0003	0.0009	0.0011	0.0013	0.0020
	(-1.21)	(-1.14)	(-0.77)	(-0.17)	(-0.13)	(0.36)	(0.46)	(0.54)	(0.78)
Security	-0.0045	-0.0046	-0.0049	-0.0041	-0.0042	-0.0044	-0.0040	-0.0041	-0.0044
	(-1.48)	(-1.50)	(-1.48)	(-1.36)	(-1.39)	(-1.36)	(-1.32)	(-1.33)	(-1.33)
Size	-0.1053***	-0.1057***	-0.1121***	-0.1064***	-0.1067***	-0.1133***	-0.1068***	-0.1071***	-0.1136***
	(-31.89)	(-31.73)	(-32.36)	(-31.23)	(-31.09)	(-31.70)	(-31.21)	(-31.10)	(-31.65)
Maturity	0.0090***	0.0091***	0.0046	0.0079**	0.0081***	0.0034	0.0072**	0.0073**	0.0028
	(2.96)	(2.99)	(1.45)	(2.57)	(2.61)	(1.05)	(2.32)	(2.35)	(0.87)
Covenant	0.1558**	0.1563**	0.1613**	0.1562**	0.1568**	0.1618**	0.1558**	0.1563**	0.1614**
	(2.19)	(2.19)	(2.22)	(2.20)	(2.19)	(2.22)	(2.18)	(2.17)	(2.21)
$D_{covenant}$	-0.1257***	-0.1264***	-0.1392***	-0.1225***	-0.1233***	-0.1356***	-0.1215***	-0.1222***	-0.1351***
	(-6.90)	(-6.91)	(-7.37)	(-6.72)	(-6.73)	(-7.18)	(-6.65)	(-6.65)	(-7.13)
AMH	-0.0000			-0.0000			0.0000		
	(-0.22)			(-0.00)			(0.16)		
AMH_missing	0.0957***			0.0953***			0.0962***		
	(19.38)			(19.44)			(19.47)		
Volume		0.0008			0.0006			0.0002	
		(0.85)			(0.61)			(0.22)	
Volume_missing		0.1056***			0.1020***			0.0978***	
		(7.98)			(7.82)			(7.50)	
Roll			0.0002			0.0002			0.0003
			(0.66)			(0.69)			(0.97)
Roll_missing			0.0443***			0.0445***			0.0459***
			(9.05)			(9.08)			(9.28)
Constant	0.7998***	0.7902***	0.8620***	0.7897***	0.7836***	0.8498***	0.8334***	0.8334***	0.8929***
	(29.87)	(26.18)	(30.22)	(30.06)	(26.22)	(30.57)	(28.12)	(24.72)	(28.23)
N	171477	171477	171477	171477	171477	171477	171477	171477	171477
Adj. R^2	0.62	0.62	0.62	0.63	0.63	0.62	0.63	0.63	0.62

Table 3. The Life-cycle of Institutional Holding Concentration and Difficulty in Learning

This table presents the relation between bond seasoning and institutional holding concentration by controlling for the level of difficulty in learning. The bond data sample spans from 1998Q1 to 2007Q2. The dependent variables are the *Holding Concentration* of institutional holdings, which is the squared ratio of the average of the percentage holding by each institution divided by the total institutional holding of a particular bond. *DiffLearn1* is the credit rating dispersion among the three major credit rating agencies: Moody's, Standard & Poor's, and Fitch. *DiffLearn2* is a dummy variable that equals one if the bond is the first issue of the firm and zero otherwise. *DiffLearn3* is a dummy variable that equals one if the bond belongs to a firm that is in the bottom 30% of all firms in terms of the number of bonds outstanding and zero otherwise. *DiffLearn4* is a dummy variable that equals one if the bond belongs to a firm that is in the bottom 30% of all firms in terms of the total outstanding amount of bonds and zero otherwise. D_{age} is a dummy variable that equals one if the bond is more than two years old and zero otherwise. *Rating* is the numerical scale of the credit ratings, ranging from 1 to 21. *Coupon* is the coupon rate of the bond in percentage. *Security* is a categorical variable that equals one if it is a senior secured bond, two if it is a senior bond, three if it is a senior subordinated bond, four if it is a junior bond, five if it is a junior subordinated bond, six if it is a subordinated bond and seven otherwise. *Size* is the natural logarithm of the total amount outstanding of the bond divided by 1,000. *Maturity* is the natural logarithm of the number of months to maturity of the bond. *Covenant* is the covenant index constructed by following Billett, King and Mauer (2007). $D_{covenant}$ is a dummy variable that equals one if any of the covenant index is not zero. *AMH* is the Amihud liquidity measure, which is constructed following Lin, Wang and Wu (2011). *AMH_missing* is a dummy variable that equals one if AMH is missing and zero otherwise. *Volume* is the natural logarithm of the total trading volume. *Volume_missing* is a dummy variable that equals one if *Volume* is missing and zero otherwise. *Roll* is Roll's liquidity measure constructed following Bao, Pan and Wang (2011). *Roll_missing* is a dummy variable that equals one if *Roll* is missing and zero otherwise. The t-statistics are reported in brackets. We control for firm and year fixed effects. The standard errors are clustered by year and firm. ***, **, and * represent statistical significance at 1%, 5% and 10%, respectively.

	Dependent Variable: Holding Concentration											
VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
D_{age}	-0.0315***	-0.0325***	-0.0285***	-0.0252***	-0.0264***	-0.0223***	-0.0272***	-0.0283***	-0.0243***	-0.0284***	-0.0294***	-0.0250***
	(-5.77)	(-5.86)	(-5.08)	(-4.51)	(-4.64)	(-3.88)	(-5.03)	(-5.15)	(-4.37)	(-5.28)	(-5.38)	(-4.52)
DiffLearn1	-0.0036***	-0.0037***	-0.0038***									
	(-3.93)	(-3.95)	(-3.96)									
D_{age}×DiffLearn1	0.0027***	0.0027***	0.0028***									
	(3.18)	(3.21)	(3.22)									
DiffLearn2				-0.0597***	-0.0610***	-0.0661***						
				(-5.14)	(-5.23)	(-5.50)						
D_{age}×DiffLearn2				0.0200**	0.0213**	0.0248**						
				(1.97)	(2.09)	(2.36)						
DiffLearn3							-0.0172*	-0.0182*	-0.0228**			
							(-1.66)	(-1.74)	(-2.14)			
D_{age}×DiffLearn3							0.0288***	0.0300***	0.0348***			
							(3.00)	(3.10)	(3.55)			
DiffLearn4										-0.0570***	-0.0563***	-0.0578***
										(-3.10)	(-3.04)	(-3.02)
D_{age}×DiffLearn4										0.0358**	0.0353**	0.0342*
										(2.06)	(2.03)	(1.89)
Rating	-0.0022	-0.0021	-0.0023	-0.0022	-0.0021	-0.0023	-0.0022	-0.0021	-0.0023	-0.0022	-0.0021	-0.0023
	(-1.31)	(-1.25)	(-1.38)	(-1.32)	(-1.26)	(-1.39)	(-1.32)	(-1.26)	(-1.40)	(-1.37)	(-1.31)	(-1.45)
Coupon	-0.0030	-0.0029	-0.0020	-0.0008	-0.0006	0.0004	-0.0030	-0.0028	-0.0019	-0.0028	-0.0027	-0.0018
	(-1.21)	(-1.14)	(-0.77)	(-0.30)	(-0.24)	(0.13)	(-1.19)	(-1.12)	(-0.74)	(-1.13)	(-1.07)	(-0.69)
Security	-0.0045	-0.0046	-0.0048	-0.0050	-0.0051*	-0.0054	-0.0045	-0.0046	-0.0049	-0.0045	-0.0046	-0.0049
	(-1.46)	(-1.48)	(-1.46)	(-1.63)	(-1.65)	(-1.63)	(-1.48)	(-1.50)	(-1.48)	(-1.46)	(-1.49)	(-1.48)
Size	-0.1053***	-0.1056***	-0.1120***	-0.1051***	-0.1054***	-0.1118***	-0.1054***	-0.1057***	-0.1121***	-0.1061***	-0.1064***	-0.1129***
	(-31.41)	(-31.27)	(-31.89)	(-31.89)	(-31.72)	(-32.34)	(-31.90)	(-31.73)	(-32.37)	(-32.46)	(-32.29)	(-32.92)
Maturity	0.0082***	0.0083***	0.0038	0.0081***	0.0082***	0.0037	0.0090***	0.0091***	0.0046	0.0089***	0.0091***	0.0045
	(2.69)	(2.72)	(1.19)	(2.64)	(2.67)	(1.15)	(2.96)	(2.99)	(1.45)	(2.93)	(2.96)	(1.43)
Covenant	0.1505**	0.1510**	0.1558**	0.1565**	0.1569**	0.1616**	0.1548**	0.1553**	0.1601**	0.1543**	0.1548**	0.1597**
	(2.15)	(2.14)	(2.17)	(2.22)	(2.22)	(2.24)	(2.18)	(2.18)	(2.20)	(2.17)	(2.16)	(2.20)
$D_{covenant}$	-0.1252***	-0.1259***	-0.1387***	-0.1244***	-0.1251***	-0.1377***	-0.1255***	-0.1262***	-0.1390***	-0.1241***	-0.1248***	-0.1375***
	(-6.94)	(-6.95)	(-7.41)	(-6.90)	(-6.90)	(-7.35)	(-6.91)	(-6.91)	(-7.37)	(-6.84)	(-6.85)	(-7.31)

(cont'd…)

	Dependent Variable: Holding Concentration											
VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
AMH	-0.0000			-0.0000			-0.0000			-0.0000		
	(-0.33)			(-0.55)			(-0.24)			(-0.22)		
AMH_missing	0.0955***			0.0950***			0.0956***			0.0956***		
	(19.50)			(19.24)			(19.38)			(19.36)		
Volume		0.0009			0.0007			0.0008			0.0007	
		(1.00)			(0.76)			(0.89)			(0.79)	
Volume_missing		0.1071***			0.1037***			0.1061***			0.1047***	
		(8.28)			(7.94)			(8.02)			(7.91)	
Roll			0.0002			0.0002			0.0002			0.0002
			(0.67)			(0.75)			(0.66)			(0.71)
Roll_missing			0.0442***			0.0439***			0.0442***			0.0444***
			(9.26)			(9.06)			(9.05)			(9.06)
Constant	0.8102***	0.7990***	0.8727***	0.7951***	0.7869***	0.8570***	0.8005***	0.7904***	0.8629***	0.8061***	0.7973***	0.8684***
	(30.50)	(27.16)	(30.76)	(29.32)	(25.83)	(29.63)	(29.88)	(26.22)	(30.24)	(29.58)	(25.98)	(30.00)
N	171477	171477	171477	171477	171477	171477	171477	171477	171477	171477	171477	171477
Adj. R^2	0.63	0.63	0.62	0.63	0.63	0.62	0.63	0.62	0.62	0.63	0.63	0.62

Table 4. Alternative Explanations

This table performs robustness checks on the relation between bond seasoning and institutional holding concentration by controlling for the level of difficulty in learning. The bond data sample spans from 1998Q1 to 2007Q2. The dependent variables are the *Holding Concentration* of institutional holdings, which is the squared ratio of the average of the percentage holding by each institution divided by the total institutional holding of a particular bond. *DiffLearn1* is the credit rating dispersion among the three major credit rating agencies: Moody's, Standard & Poor's, and Fitch. *DiffLearn2* is a dummy variable that equals one if the bond is the first issue of the firm and zero otherwise. *DiffLearn3* is a dummy variable that equals one if the bond belongs to a firm that is in the bottom 30% of all firms in terms of the number of bonds outstanding and zero otherwise. *DiffLearn4* is a dummy variable that equals one if the bond belongs to a firm that belongs to the bottom 30% of all firms in terms of the total outstanding amount of bonds and zero otherwise. D_{age} is a dummy variable that equals one if the bond is more than two years old and zero otherwise. Other control variables include *Rating*, *Coupon*, *Security*, *Size*, *Maturity*, *Covenant*, $D_{covenant}$, *AMH*, *AMH_missing*, *Volume*, *Volume_missing*, *Roll*, and *Roll_missing*: these variables are defined as in Table 1. The t-statistics are reported in brackets. We control for firm and year fixed effects. The standard errors are clustered by year and firm. Panel A further controls for the interaction between the seasoning dummy D_{age} and the credit ratings. Panel B further includes interactions between *Maturity* and *DiffLearn1*, *DiffLearn2*, *DiffLearn3* and *DiffLearn4*. Panel C further includes the interactions between all other control variables and *DiffLearn1*, *DiffLearn2*, *DiffLearn3* and *DiffLearn4*. ***, **, and * represent statistical significance at 1%, 5% and 10%, respectively.

Panel A: Rating Effect

	Dependent Variable: Holding Concentration											
VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
D_{age}	-0.0715***	-0.0727***	-0.0717***	-0.0624***	-0.0637***	-0.0623***	-0.0623***	-0.0635***	-0.0621***	-0.0648***	-0.0660***	-0.0647***
	(-5.62)	(-5.65)	(-5.57)	(-5.57)	(-5.62)	(-5.46)	(-5.62)	(-5.66)	(-5.50)	(-5.91)	(-5.94)	(-5.77)
DiffLearn1	-0.0039***	-0.0039***	-0.0040***									
	(-4.39)	(-4.39)	(-4.43)									
D_{age}×DiffLearn1	0.0029***	0.0029***	0.0031***									
	(3.76)	(3.76)	(3.83)									
DiffLearn2				-0.0562***	-0.0576***	-0.0624***						
				(-4.89)	(-4.98)	(-5.25)						
D_{age}×DiffLearn2				0.0156	0.0169*	0.0201*						
				(1.55)	(1.67)	(1.93)						
DiffLearn3							-0.0135	-0.0144	-0.0187*			
							(-1.29)	(-1.38)	(-1.76)			
D_{age}×DiffLearn3							0.0234**	0.0245**	0.0290***			
							(2.45)	(2.55)	(2.98)			
DiffLearn4										-0.0548***	-0.0541***	-0.0555***
										(-3.00)	(-2.95)	(-2.92)
D_{age}×DiffLearn4										0.0320*	0.0315*	0.0301*
										(1.87)	(1.84)	(1.69)
Rating	-0.0079***	-0.0078***	-0.0084***	-0.0076***	-0.0075***	-0.0081***	-0.0073***	-0.0072***	-0.0078***	-0.0075***	-0.0074***	-0.0081***
	(-4.35)	(-4.33)	(-4.66)	(-4.60)	(-4.56)	(-4.90)	(-4.43)	(-4.39)	(-4.72)	(-4.53)	(-4.50)	(-4.86)
D_{age}×Rating	0.0062***	0.0062***	0.0067***	0.0059***	0.0059***	0.0064***	0.0056***	0.0056***	0.0060***	0.0058***	0.0058***	0.0063***
	(3.41)	(3.39)	(3.63)	(3.54)	(3.50)	(3.73)	(3.35)	(3.32)	(3.54)	(3.55)	(3.52)	(3.77)
Control Variables	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Cluster by Year and Firm	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
N	171477	171477	171477	171477	171477	171477	171477	171477	171477	171477	171477	171477
Adj. R^2	0.63	0.63	0.62	0.63	0.63	0.62	0.63	0.63	0.62	0.63	0.63	0.62

Panel B: Maturity Effect

	Dependent Variable: Holding Concentration											
VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
D_{age}	-0.0713***	-0.0725***	-0.0714***	-0.0625***	-0.0638***	-0.0622***	-0.0621***	-0.0633***	-0.0617***	-0.0660***	-0.0672***	-0.0660***
	(-5.53)	(-5.57)	(-5.47)	(-5.55)	(-5.60)	(-5.42)	(-5.59)	(-5.63)	(-5.45)	(-6.10)	(-6.13)	(-5.97)
DiffLearn1	-0.0004	-0.0004	0.0001									
	(-0.24)	(-0.26)	(0.03)									
D_{age}×DiffLearn1	0.0027***	0.0027***	0.0027***									
	(3.40)	(3.40)	(3.42)									
DiffLearn2				-0.0619**	-0.0633**	-0.0570**						
				(-2.51)	(-2.56)	(-2.22)						
D_{age}×DiffLearn2				0.0162	0.0175	0.0195*						
				(1.52)	(1.64)	(1.77)						
DiffLearn3							0.0182	0.0178	0.0339			
							(0.76)	(0.74)	(1.38)			
D_{age}×DiffLearn3							0.0187*	0.0198*	0.0212**			
							(1.86)	(1.95)	(2.06)			
DiffLearn4										-0.1224***	-0.1220***	-0.1302***
										(-3.47)	(-3.45)	(-3.60)
D_{age}×DiffLearn4										0.0414**	0.0410**	0.0405**
										(2.34)	(2.30)	(2.20)
Maturity×DiffLearn1	-0.0009***	-0.0009***	-0.0011***									
	(-2.67)	(-2.64)	(-3.00)									
Maturity×DiffLearn2				0.0013	0.0013	-0.0012						
				(0.26)	(0.26)	(-0.24)						
Maturity×DiffLearn3							-0.0073	-0.0074	-0.0121**			
							(-1.42)	(-1.44)	(-2.30)			
Maturity×DiffLearn4										0.0157**	0.0157**	0.0173***
										(2.44)	(2.45)	(2.63)
Control Variables	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Cluster by Year and Firm	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
N	171477	171477	171477	171477	171477	171477	171477	171477	171477	171477	171477	171477
Adj. R^2	0.63	0.63	0.62	0.63	0.63	0.62	0.63	0.63	0.62	0.63	0.63	0.62

Panel C: Other Missing Variables

	Dependent Variable: Holding Concentration											
VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
D_{age}	-0.0709***	-0.0719***	-0.0709***	-0.0668***	-0.0686***	-0.0662***	-0.0632***	-0.0649***	-0.0629***	-0.0741***	-0.0752***	-0.0744***
	(-5.36)	(-5.38)	(-5.30)	(-5.79)	(-5.90)	(-5.66)	(-5.63)	(-5.72)	(-5.51)	(-7.25)	(-7.26)	(-7.14)
DiffLearn1	-0.0034	-0.0036	-0.0032									
	(-1.22)	(-1.30)	(-1.10)									
D_{age}×DiffLearn1	0.0032***	0.0031***	0.0033***									
	(3.89)	(3.74)	(3.91)									
DiffLearn2				-0.1658***	-0.1584***	-0.1615***						
				(-3.40)	(-3.19)	(-3.18)						
D_{age}×DiffLearn2				0.0213**	0.0276***	0.0237**						
				(2.03)	(2.59)	(2.19)						
DiffLearn3							-0.2926***	-0.2909***	-0.2885***			
							(-5.58)	(-5.42)	(-5.39)			
D_{age}×DiffLearn3							0.0220**	0.0285***	0.0242**			
							(2.19)	(2.78)	(2.36)			
DiffLearn4										-0.1967***	-0.1987***	-0.2130***
										(-2.88)	(-2.91)	(-3.09)
D_{age}×DiffLearn4										0.0526***	0.0518***	0.0523***
										(3.46)	(3.39)	(3.34)
Control Variables	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Cluster by Year and Firm	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
N	171477	171477	171477	171477	171477	171477	171477	171477	171477	171477	171477	171477
Adj. R^2	0.63	0.63	0.62	0.63	0.63	0.62	0.63	0.63	0.62	0.63	0.63	0.62

Table 5. The Source of Information and Seasoning

This table tests the relation between bond seasoning and two measures of the information ambiguity of the bond. The data sample spans from 1999Q1 to 2007Q2. The dependent variables are two measures of *information ambiguity* derived from credit rating reports released by Standard and Poor's. Panel A uses the interaction of the minimum of the positive or negative tone in each credit rating report defined in Loughran and McDonald (2011) and the proportion of sentences that fall into "Industry" and "Macroeconomics" categories defined in Agarwal, Chen and Zhang (2015). Panel B uses the interaction of report complexity measure FOG index defined in Gunning (1952) and the proportion of sentences that fall into "Industry" and "Macroeconomics" categories. D_{age} is a dummy variable that equals one if the age of the bond is more than two years old and zero otherwise. $D1_{age}$ is a dummy variable that equals one if the age of the bond is more than two but less than five years old and zero otherwise. $D2_{age}$ is a dummy variable that equals one if the age of the bond is more than five years old and zero otherwise. *Age* is the natural logarithm of the age of the bond in calendar months. Control variables include *Rating*, *Coupon*, *Security*, *Size*, *Covenant*, $D_{covenant}$, *AMH*, *AMH_missing*, *Volume*, *Volume_missing*, *Roll*, and *Roll_missing* defined in Table 1. The t-statistics are reported in brackets. The standard errors are clustered by year and firm. ***, **, and * represent statistical significance at 1%, 5% and 10%, respectively.

Panel A: Dependent Variable: MIN_TONE*(IND+MACRO)

VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
D_{age}	-0.0267*	-0.0251*	-0.0264*						
	(-2.05)	(-1.86)	(-1.99)						
$D1_{age}$				0.0489	0.0490	0.0506			
				(0.96)	(0.98)	(0.92)			
$D2_{age}$				-0.0661**	-0.0648**	-0.0661**			
				(-2.80)	(-2.33)	(-3.09)			
Age							-0.0254**	-0.0246*	-0.0256**
							(-2.37)	(-1.95)	(-2.51)
Control Variables	YES	YES	YES	YES	YES	YES	YES	YES	YES
Cluster by Year	YES	YES	YES	YES	YES	YES	YES	YES	YES
N	1013	1013	1013	1013	1013	1013	1013	1013	1013
Adj. R^2	0.02	0.02	0.02	0.07	0.07	0.07	0.03	0.03	0.03

Panel B: Dependent Variable: FOG*(IND+MACRO)

VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
D_{age}	-0.2377*	-0.2241*	-0.2374**						
	(-2.13)	(-1.90)	(-2.35)						
$D1_{age}$				0.1750	0.1769	0.1795			
				(0.74)	(0.76)	(0.71)			
$D2_{age}$				-0.4529**	-0.4391*	-0.4524**			
				(-2.44)	(-2.16)	(-2.65)			
Age							-0.1655**	-0.1573*	-0.1661**
							(-2.58)	(-2.15)	(-2.83)
Control Variables	YES	YES	YES	YES	YES	YES	YES	YES	YES
Cluster by Year	YES	YES	YES	YES	YES	YES	YES	YES	YES
N	1013	1013	1013	1013	1013	1013	1013	1013	1013
Adj. R^2	0.02	0.02	0.02	0.05	0.05	0.05	0.02	0.02	0.02

Table 6. The Source of Information vs. Large Shocks in Term Structure

This table tests the relation between bond seasoning and three measures of the information ambiguity of the bond. The data sample spans from 1999Q1 to 2007Q2. The dependent variables are two measures of *information ambiguity* derived from credit rating reports released by Standard and Poor's. Panel A and Panel C use the interaction of the minimum of the positive or negative tone in each credit rating report defined in Loughran and McDonald (2011) and the proportion of sentences that fall into "Industry" and "Macroeconomics" categories defined in Agarwal, Chen and Zhang (2015). Panel B and Panel D use the interaction of report complexity measure FOG index defined in Gunning (1952) and the proportion of sentences that fall into "Industry" and "Macroeconomics" categories. D_{age} is a dummy variable that equals one if the age of the bond is more than two years old and zero otherwise. $D1_{age}$ is a dummy variable that equals one if the age of the bond is more than two but less than five years old and zero otherwise. $D2_{age}$ is a dummy variable that equals one if the age of the bond is more than five years old and zero otherwise. *Age* is the natural logarithm of the age of the bond in calendar months. $TSCS_1$ is the dummy variable that equals 1 if the term structure of credit risk proxied by the monthly absolute percentage change of credit spread between the 20-year Constant Treasury yield and the 1-year Constant Treasury yield is in the top 50 percentile during the sample period. $TSCS_2$ is the dummy variable that equals 1 if the term structure of credit risk proxied by the monthly absolute percentage change of credit spread between the 20-year Constant Treasury yield and the 5-year Constant Treasury yield is in the top 50 percentile during the sample period. Control variables include *Rating*, *Coupon*, *Security, Size*, *Covenant*, $D_{covenant}$, *AMH, AMH_missing, Volume, Volume_missing, Roll,* and *Roll_missing* defined in Table 1. The t-statistics are reported in brackets. The standard errors are clustered by year and firm. Panel A and Panel B employ the key variable $TSCS_1$. Panel C and Panel D employ the key variable $TSCS_2$ respectively. ***, **, and * represent statistical significance at 1%, 5% and 10%, respectively.

Panel A: Dependent Variable: MIN_TONE*(IND+MACRO)

VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
D_{age}	-0.0257	-0.0236*	-0.0238						
	(-1.76)	(-2.01)	(-1.23)						
$D1_{age}$				0.0697	0.0702	0.0727			
				(1.22)	(1.24)	(1.16)			
$D2_{age}$				-0.0685**	-0.0664**	-0.0671**			
				(-2.90)	(-2.57)	(-3.16)			
Age							-0.0201*	-0.0189	-0.0200*
							(-2.03)	(-1.72)	(-2.13)
$TSCS_1$	-0.1251**	-0.1264**	-0.1189**	-0.1171**	-0.1185**	-0.1119**	-0.2004*	-0.2111*	-0.1896**
	(-2.45)	(-2.42)	(-2.69)	(-2.47)	(-2.44)	(-2.68)	(-2.02)	(-2.08)	(-2.30)
$TSCS_1 \times D_{age}$	0.0623*	0.0627*	0.0536*						
	(2.24)	(2.21)	(1.85)						
$TSCS_1 \times D1_{age}$				-0.0567	-0.0574	-0.0641			
				(-0.98)	(-1.01)	(-0.98)			
$TSCS_1 \times D2_{age}$				0.0869**	0.0878**	0.0796**			
				(2.52)	(2.43)	(2.63)			
$TSCS_1 \times$Age							0.0311	0.0332	0.0282
							(1.48)	(1.52)	(1.52)
Control Variables	YES	YES	YES	YES	YES	YES	YES	YES	YES
Cluster by Year	YES	YES	YES	YES	YES	YES	YES	YES	YES
N	1013	1013	1013	1013	1013	1013	1013	1013	1013
Adj. R^2	0.05	0.05	0.05	0.10	0.10	0.10	0.05	0.06	0.05

Panel B: Dependent Variable: FOG*(IND+MACRO)									
VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
D_{age}	-0.2811***	-0.2657***	-0.2703***						
	(-4.35)	(-4.03)	(-3.80)						
$D1_{age}$				0.2726	0.2769	0.2872			
				(1.05)	(1.08)	(1.02)			
$D2_{age}$				-0.5276***	-0.5101**	-0.5173***			
				(-3.40)	(-2.92)	(-3.77)			
Age							-0.1623***	-0.1529**	-0.1608***
							(-3.54)	(-2.77)	(-4.34)
$TSCS_1$	-0.6724**	-0.6799**	-0.6457**	-0.6274**	-0.6363**	-0.6074**	-1.1581*	-1.2278*	-1.1406*
	(-2.50)	(-2.44)	(-2.70)	(-2.51)	(-2.46)	(-2.73)	(-1.88)	(-1.98)	(-1.98)
$TSCS_1 \times D_{age}$	0.4630**	0.4656*	0.4185*						
	(2.26)	(2.21)	(2.07)						
$TSCS_1 \times D1_{age}$				-0.2536	-0.2583	-0.2968			
				(-0.79)	(-0.82)	(-0.83)			
$TSCS_1 \times D2_{age}$				0.6109**	0.6163**	0.5754**			
				(2.69)	(2.57)	(2.80)			
$TSCS_1 \times$Age							0.2141	0.2281	0.2066
							(1.62)	(1.69)	(1.65)
Control Variables	YES	YES	YES	YES	YES	YES	YES	YES	YES
Cluster by Year	YES	YES	YES	YES	YES	YES	YES	YES	YES
N	1013	1013	1013	1013	1013	1013	1013	1013	1013
Adj. R^2	0.03	0.03	0.03	0.06	0.07	0.07	0.03	0.03	0.03

Panel C: Dependent Variable: MIN_TONE*(IND+MACRO)									
VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
D_{age}	-0.0713**	-0.0689**	-0.0686**						
	(-3.05)	(-3.06)	(-2.63)						
$D1_{age}$				0.0666	0.0675	0.0702			
				(0.89)	(0.91)	(0.88)			
$D2_{age}$				-0.1396***	-0.1376**	-0.1380***			
				(-3.44)	(-3.22)	(-3.48)			
Age							-0.0428*	-0.0417*	-0.0423*
							(-2.05)	(-1.89)	(-2.04)
$TSCS_2$	-0.0658	-0.0634	-0.0607	-0.0622	-0.0610	-0.0584	-0.1322	-0.1288	-0.1255
	(-1.64)	(-1.60)	(-1.49)	(-1.69)	(-1.67)	(-1.56)	(-1.15)	(-1.13)	(-1.07)
$TSCS_2 \times D_{age}$	0.0778**	0.0764**	0.0736**						
	(3.17)	(2.99)	(2.84)						
$TSCS_2 \times D1_{age}$				-0.0621	-0.0632	-0.0652			
				(-0.95)	(-0.96)	(-0.95)			
$TSCS_2 \times D2_{age}$				0.1212***	0.1203***	0.1183***			
				(3.86)	(3.89)	(3.74)			
$TSCS_2 \times$Age							0.0326	0.0319	0.0313
							(1.63)	(1.62)	(1.54)
Control Variables	YES	YES	YES	YES	YES	YES	YES	YES	YES
Cluster by Year	YES	YES	YES	YES	YES	YES	YES	YES	YES
N	1013	1013	1013	1013	1013	1013	1013	1013	1013
Adj. R^2	0.02	0.03	0.02	0.10	0.10	0.10	0.03	0.03	0.03

Panel D: Dependent Variable: FOG*(IND+MACRO)									
VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
D_{age}	-0.5708***	-0.5538***	-0.5566***						
	(-7.20)	(-6.86)	(-6.57)						
$D1_{age}$				0.1405	0.1458	0.1561			
				(0.38)	(0.40)	(0.40)			
$D2_{age}$				-0.9283***	-0.9114***	-0.9183***			
				(-4.36)	(-4.01)	(-4.54)			
Age							-0.2752**	-0.2658**	-0.2715**
							(-2.98)	(-2.65)	(-3.06)
$TSCS_2$	-0.5228**	-0.5118**	-0.4921**	-0.5037**	-0.4994**	-0.4802**	-0.8654	-0.8504	-0.8197
	(-2.71)	(-2.67)	(-2.52)	(-2.85)	(-2.85)	(-2.68)	(-1.54)	(-1.52)	(-1.44)
$TSCS_2 \times D_{age}$	0.5775***	0.5718***	0.5552***						
	(4.25)	(4.09)	(3.63)						
$TSCS_2 \times D1_{age}$				-0.0933	-0.0980	-0.1095			
				(-0.27)	(-0.28)	(-0.30)			
$TSCS_2 \times D2_{age}$				0.7924***	0.7894***	0.7767***			
				(4.63)	(4.67)	(4.31)			
$TSCS_2 \times Age$							0.2062*	0.2034*	0.1978
							(1.87)	(1.88)	(1.77)
Control Variables	YES	YES	YES	YES	YES	YES	YES	YES	YES
Cluster by Year	YES	YES	YES	YES	YES	YES	YES	YES	YES
N	1013	1013	1013	1013	1013	1013	1013	1013	1013
Adj. R^2	0.02	0.02	0.02	0.07	0.07	0.07	0.03	0.03	0.03

Table 7. Learning vs. Term Structure Shocks

This table tests the relation between bond seasoning and learning of the term structure of credit risk. The bond data sample spans from 1998Q1 to 2007Q2. The dependent variables are *Holding Concentration* of institutional holdings, which is the squared ratio of the average of the percentage holding by each institution divided by the total institutional holding of a particular bond. D_{age} is a dummy variable that equals one if the bond is more than two years old and zero otherwise. $D1_{age}$ is a dummy variable that equals one if the bond is more than two but less than five years old and zero otherwise. $D2_{age}$ is a dummy variable that equals one if the bond is more than five years old and zero otherwise. *Age* is the natural logarithm of the age of the bond. $TSCS_1$ is the dummy variable that equals 1 if the term structure of credit risk proxied by the monthly absolute percentage change of credit spread between the 20-year Constant Treasury yield and the 1-year Constant Treasury yield is in the top 50 percentile during the sample period. $TSCS_2$ is the dummy variable that equals 1 if the term structure of credit risk proxied by the monthly absolute percentage change of credit spread between the 20-year Constant Treasury yield and the 5-year Constant Treasury yield is in the top 50 percentile during the sample period. *Rating*, *Coupon*, *Security*, *Size*, *Maturity*, *Covenant*, $D_{covenant,}$ *AMH*, *AMH_missing*, *Volume*, *Roll*, and *Roll_missing* are defined in Table 1. The t-statistics are reported in brackets. We control for firm and year fixed effects. The standard errors are clustered by year and firm. Panel A and Panel B employs the key variable $TSCS_1$ and $TSCS_2$ respectively. ***, **, and * represent statistical significance at 1%, 5% and 10%, respectively.

Panel A: Learning about *$TSCS_1$*

	Dependent Variable: Holding Concentration								
VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
D_{age}	-0.0272***	-0.0284***	-0.0237***						
	(-5.15)	(-5.28)	(-4.36)						
$D1_{age}$				-0.0228***	-0.0240***	-0.0190***			
				(-4.50)	(-4.65)	(-3.66)			
$D2_{age}$				-0.0437***	-0.0446***	-0.0422***			
				(-5.18)	(-5.22)	(-4.81)			
Age							-0.0220***	-0.0228***	-0.0205***
							(-5.76)	(-5.85)	(-5.14)
$TSCS_1$	-0.0116***	-0.0119***	-0.0107***	-0.0116***	-0.0119***	-0.0106***	-0.0241***	-0.0246***	-0.0203***
	(-3.45)	(-3.53)	(-3.11)	(-3.43)	(-3.51)	(-3.09)	(-3.58)	(-3.67)	(-2.93)
$TSCS_1 \times D_{age}$	0.0067*	0.0072*	0.0055						
	(1.77)	(1.89)	(1.43)						
$TSCS_1 \times D1_{age}$				0.0024	0.0029	0.0017			
				(0.59)	(0.69)	(0.42)			
$TSCS_1 \times D2_{age}$				0.0102**	0.0106***	0.0089**			
				(2.55)	(2.66)	(2.16)			
$TSCS_1 \times$Age							0.0047***	0.0049***	0.0037**
							(2.85)	(2.95)	(2.20)
Rating	-0.0022	-0.0021	-0.0023	-0.0022	-0.0021	-0.0023	-0.0022	-0.0022	-0.0024
	(-1.33)	(-1.27)	(-1.41)	(-1.31)	(-1.25)	(-1.38)	(-1.32)	(-1.27)	(-1.40)
Coupon	-0.0030	-0.0029	-0.0020	-0.0005	-0.0004	0.0008	0.0010	0.0012	0.0019
	(-1.21)	(-1.14)	(-0.77)	(-0.21)	(-0.18)	(0.32)	(0.42)	(0.50)	(0.75)
Security	-0.0045	-0.0046	-0.0049	-0.0041	-0.0042	-0.0045	-0.0040	-0.0041	-0.0044
	(-1.47)	(-1.50)	(-1.48)	(-1.37)	(-1.39)	(-1.36)	(-1.31)	(-1.33)	(-1.33)
Size	-0.1053***	-0.1057***	-0.1121***	-0.1064***	-0.1067***	-0.1132***	-0.1068***	-0.1071***	-0.1135***
	(-31.88)	(-31.72)	(-32.36)	(-31.24)	(-31.10)	(-31.71)	(-31.21)	(-31.10)	(-31.65)
Maturity	0.0090***	0.0091***	0.0046	0.0079***	0.0081***	0.0034	0.0072**	0.0073**	0.0028
	(2.96)	(2.99)	(1.45)	(2.58)	(2.62)	(1.07)	(2.33)	(2.36)	(0.87)
Covenant	0.1560**	0.1566**	0.1615**	0.1566**	0.1572**	0.1621**	0.1561**	0.1567**	0.1616**
	(2.19)	(2.19)	(2.22)	(2.20)	(2.20)	(2.23)	(2.18)	(2.18)	(2.21)
$D_{covenant}$	-0.1258***	-0.1265***	-0.1393***	-0.1228***	-0.1236***	-0.1358***	-0.1218***	-0.1224***	-0.1353***
	(-6.91)	(-6.92)	(-7.38)	(-6.73)	(-6.75)	(-7.19)	(-6.67)	(-6.67)	(-7.15)
AMH	-0.0000			0.0000			0.0000		
	(-0.20)			(0.06)			(0.22)		
AMH_missing	0.0957***			0.0954***			0.0962***		
	(19.39)			(19.46)			(19.49)		
Volume		0.0008			0.0006			0.0002	
		(0.88)			(0.65)			(0.26)	
Volume_missing		0.1060***			0.1026***			0.0985***	
		(8.01)			(7.88)			(7.56)	
Roll			0.0002			0.0002			0.0003
			(0.68)			(0.70)			(0.98)
Roll_missing			0.0443***			0.0445***			0.0459***
			(9.06)			(9.10)			(9.29)
Constant	0.8044***	0.7945***	0.8664***	0.7950***	0.7885***	0.8549***	0.8417***	0.8412***	0.9001***
	(30.02)	(26.31)	(30.36)	(30.29)	(26.42)	(30.77)	(28.47)	(24.97)	(28.55)
N	171477	171477	171477	171477	171477	171477	171477	171477	171477
Adj. R^2	0.63	0.62	0.62	0.63	0.63	0.62	0.63	0.63	0.62

Panel B: Learning about $TSCS_2$

	Dependent Variable: Holding Concentration								
VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
D_{age}	-0.0314***	-0.0324***	-0.0281***						
	(-5.93)	(-6.04)	(-5.19)						
$D1_{age}$				-0.0266***	-0.0278***	-0.0231***			
				(-5.10)	(-5.23)	(-4.33)			
$D2_{age}$				-0.0489***	-0.0496***	-0.0477***			
				(-5.87)	(-5.91)	(-5.51)			
Age							-0.0241***	-0.0248***	-0.0226***
							(-6.42)	(-6.50)	(-5.80)
$TSCS_2$	-0.0198***	-0.0200***	-0.0197***	-0.0208***	-0.0210***	-0.0208***	-0.0423***	-0.0427***	-0.0405***
	(-5.68)	(-5.75)	(-5.51)	(-6.01)	(-6.05)	(-5.85)	(-6.09)	(-6.19)	(-5.80)
$TSCS_2 \times D_{age}$	0.0206***	0.0209***	0.0207***						
	(5.28)	(5.36)	(5.15)						
$TSCS_2 \times D1_{age}$				0.0164***	0.0167***	0.0170***			
				(4.00)	(4.07)	(4.00)			
$TSCS_2 \times D2_{age}$				0.0247***	0.0249***	0.0246***			
				(5.94)	(5.99)	(5.80)			
$TSCS_2 \times Age$							0.0100***	0.0101***	0.0096***
							(5.87)	(5.98)	(5.60)
Rating	-0.0022	-0.0021	-0.0024	-0.0022	-0.0021	-0.0023	-0.0022	-0.0022	-0.0024
	(-1.34)	(-1.28)	(-1.41)	(-1.31)	(-1.25)	(-1.38)	(-1.32)	(-1.27)	(-1.40)
Coupon	-0.0032	-0.0030	-0.0022	-0.0006	-0.0005	0.0007	0.0009	0.0011	0.0018
	(-1.29)	(-1.22)	(-0.84)	(-0.25)	(-0.21)	(0.28)	(0.35)	(0.44)	(0.69)
Security	-0.0046	-0.0047	-0.0050	-0.0042	-0.0043	-0.0046	-0.0041	-0.0042	-0.0045
	(-1.50)	(-1.53)	(-1.51)	(-1.40)	(-1.42)	(-1.39)	(-1.36)	(-1.37)	(-1.37)
Size	-0.1052***	-0.1056***	-0.1120***	-0.1062***	-0.1066***	-0.1131***	-0.1067***	-0.1070***	-0.1134***
	(-31.86)	(-31.70)	(-32.34)	(-31.15)	(-31.02)	(-31.63)	(-31.15)	(-31.04)	(-31.59)
Maturity	0.0091***	0.0092***	0.0047	0.0079***	0.0081***	0.0034	0.0072**	0.0074**	0.0029
	(2.99)	(3.02)	(1.48)	(2.59)	(2.63)	(1.07)	(2.34)	(2.38)	(0.89)
Covenant	0.1567**	0.1572**	0.1622**	0.1571**	0.1576**	0.1626**	0.1569**	0.1574**	0.1624**
	(2.21)	(2.20)	(2.23)	(2.21)	(2.21)	(2.24)	(2.20)	(2.19)	(2.22)
$D_{covenant}$	-0.1261***	-0.1268***	-0.1397***	-0.1229***	-0.1237***	-0.1360***	-0.1221***	-0.1227***	-0.1356***
	(-6.94)	(-6.94)	(-7.40)	(-6.75)	(-6.76)	(-7.21)	(-6.69)	(-6.69)	(-7.17)
AMH	-0.0000			-0.0000			-0.0000		
	(-0.32)			(-0.20)			(-0.09)		
AMH_missing	0.0956***			0.0953***			0.0962***		
	(19.40)			(19.48)			(19.50)		
Volume		0.0009			0.0007			0.0003	
		(0.94)			(0.73)			(0.35)	
Volume_missing		0.1068***			0.1035***			0.0995***	
		(8.11)			(7.99)			(7.69)	
Roll			0.0002			0.0002			0.0003
			(0.61)			(0.64)			(0.92)
Roll_missing			0.0440***			0.0443***			0.0457***
			(9.07)			(9.11)			(9.32)
Constant	0.8049***	0.7941***	0.8673***	0.7945***	0.7870***	0.8549***	0.8458***	0.8441***	0.9049***
	(30.13)	(26.36)	(30.49)	(30.32)	(26.40)	(30.82)	(28.57)	(25.04)	(28.68)
N	171477	171477	171477	171477	171477	171477	171477	171477	171477
Adj. R^2	0.63	0.63	0.62	0.63	0.63	0.62	0.63	0.63	0.62

Table 8. Learning by Different Types of Investors

This table tests the relation between bond seasoning and the institutional holding concentration of short-term investors. The bond data sample spans from 1998Q1 to 2007Q2. The dependent variables are *Holding Concentration* of institutional holdings held by short-term investors in Panel A, the percentage of institutional holdings held by short-term investors (i.e., *Short-term Holding*) in Panel B, and the percentage of institutional holdings held by long-term investors (i.e., *Long-term Holding*) in Panel C. *Holding Concentration* is the squared ratio of the average of the percentage holding held by short-term investors divided by the total institutional holding of a particular bond. Short-term investors include holdings by annuities/variable annuities, finance companies, hedge funds, investment managers and mutual funds. Long-term investors include the remaining institutional investors. *DiffLearn1* is the credit rating dispersion among the three major credit rating agencies: Moody's, Standard & Poor's, and Fitch. *DiffLearn2* is a dummy variable that equals one if the bond is the first issue of the firm and zero otherwise. *DiffLearn3* is a dummy variable that equals one if the bond belongs to a firm that is in the bottom 30% of all firms in terms of the number of bonds outstanding and zero otherwise. *DiffLearn4* is a dummy variable that equals one if the bond belongs to a firm that is in the bottom 30% of all firms in terms of the total outstanding amount of bonds and zero otherwise. D_{age} is a dummy variable that equals one if the bond is more than two years old and zero otherwise. Control variables include *Rating*, *Coupon*, *Security*, *Size*, *Maturity*, *Covenant*, $D_{covenant}$, *AMH*, *AMH_missing*, *Volume*, *Volume_missing*, *Roll*, and *Roll_missing* as defined in Table 1. Other control variables further include all interactions between all other control variables and *DiffLearn1*, *DiffLearn2*, *DiffLearn3* and *DiffLearn4*. We control for firm and year fixed effects. The standard errors are clustered by year and firm. ***, **, and * represent statistical significance at 1%, 5% and 10%, respectively.

Panel A: Concentration of Short-term Investors

	Dependent Variable: Short-Term Holding Concentration											
VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
D_{age}	-0.0279***	-0.0281***	-0.0279***	-0.0275***	-0.0279***	-0.0275***	-0.0265***	-0.0267***	-0.0265***	-0.0266***	-0.0269***	-0.0267***
	(-6.28)	(-6.30)	(-6.27)	(-6.93)	(-6.99)	(-6.89)	(-6.64)	(-6.68)	(-6.61)	(-6.70)	(-6.74)	(-6.68)
DiffLearn1	-0.0015*	-0.0015*	-0.0015									
	(-1.67)	(-1.68)	(-1.64)									
D_{age}×DiffLearn1	0.0006**	0.0006**	0.0006**									
	(2.24)	(2.21)	(2.24)									
DiffLearn2				0.0009	0.0020	0.0007						
				(0.06)	(0.14)	(0.05)						
D_{age}×DiffLearn2				0.0181***	0.0188***	0.0182***						
				(5.37)	(5.49)	(5.38)						
DiffLearn3							-0.0440	-0.0438	-0.0443			
							(-1.38)	(-1.37)	(-1.38)			
D_{age}×DiffLearn3							0.0176***	0.0181***	0.0178***			
							(4.78)	(4.83)	(4.80)			
DiffLearn4										-0.0523	-0.0526	-0.0543
										(-1.57)	(-1.57)	(-1.63)
D_{age}×DiffLearn4										0.0094	0.0095	0.0093
										(1.25)	(1.27)	(1.24)
Control Variables	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Cluster by Year and Firm	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
N	149489	149489	149489	149489	149489	149489	149489	149489	149489	149489	149489	149489
Adj. R^2	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09

Panel B: Institutional Holdings of Short-term Investors

	Dependent Variable: Short-Term Institutional Holdings											
VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
D_{age}	-0.0778***	-0.0775***	-0.0777***	-0.0796***	-0.0794***	-0.0795***	-0.0771***	-0.0769***	-0.0770***	-0.0756***	-0.0756***	-0.0755***
	(-6.94)	(-6.88)	(-6.90)	(-7.57)	(-7.51)	(-7.53)	(-7.28)	(-7.20)	(-7.24)	(-7.21)	(-7.17)	(-7.16)
DiffLearn1	-0.0016	-0.0016	-0.0015									
	(-0.74)	(-0.74)	(-0.73)									
D_{age}×DiffLearn1	0.0006	0.0007	0.0006									
	(0.94)	(1.05)	(0.96)									
DiffLearn2				0.0515	0.0530	0.0518						
				(1.14)	(1.17)	(1.14)						
D_{age}×DiffLearn2				0.0239**	0.0249**	0.0241**						
				(2.32)	(2.40)	(2.34)						
DiffLearn3							-0.0592	-0.0592	-0.0583			
							(-0.97)	(-0.97)	(-0.96)			
D_{age}×DiffLearn3							0.0290**	0.0297**	0.0291**			
							(2.50)	(2.54)	(2.51)			
DiffLearn4										-0.0348	-0.0353	-0.0356
										(-0.59)	(-0.60)	(-0.61)
D_{age}×DiffLearn4										0.0259*	0.0282*	0.0261*
										(1.79)	(1.93)	(1.81)
Control Variables	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Cluster by Year and Firm	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
N	149489	149489	149489	149489	149489	149489	149489	149489	149489	149489	149489	149489
Adj. R^2	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26

Panel C: Institutional Holdings of Long-term Investors

	Dependent Variable: Long-Term Institutional Holdings											
VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
D_{age}	0.0997***	0.0988***	0.0998***	0.1015***	0.1003***	0.1016***	0.0987***	0.0975***	0.0989***	0.0913***	0.0906***	0.0914***
	(8.62)	(8.49)	(8.62)	(9.43)	(9.26)	(9.43)	(9.14)	(8.96)	(9.14)	(8.44)	(8.33)	(8.43)
DiffLearn1	0.0014	0.0015	0.0014									
	(0.51)	(0.52)	(0.51)									
D_{age}×DiffLearn1	-0.0005	-0.0006	-0.0005									
	(-0.74)	(-0.90)	(-0.72)									
DiffLearn2				-0.1191**	-0.1180**	-0.1186**						
				(-2.40)	(-2.38)	(-2.39)						
D_{age}×DiffLearn2				-0.0404***	-0.0400***	-0.0401***						
				(-3.71)	(-3.66)	(-3.69)						
DiffLearn3							-0.0012	0.0001	-0.0012			
							(-0.02)	(0.00)	(-0.02)			
D_{age}×DiffLearn3							-0.0516***	-0.0509***	-0.0514***			
							(-4.19)	(-4.13)	(-4.18)			
DiffLearn4										0.0077	0.0080	0.0069
										(0.12)	(0.13)	(0.11)
D_{age}×DiffLearn4										-0.0415**	-0.0442***	-0.0414**
										(-2.56)	(-2.71)	(-2.57)
Control Variables	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Cluster by Year and Firm	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
N	149489	149489	149489	149489	149489	149489	149489	149489	149489	149489	149489	149489
Adj. R^2	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27

Table 9. Learning and Liquidity

This table tests the relation between bond seasoning and bond liquidity. The bond data sample spans from 1998Q1 to 2007Q2. The dependent variables are three liquidity constructs. *AMH* is the Amihud liquidity measure, which is constructed following Lin, Wang and Wu (2011). *Volume* is the natural logarithm of the total trading volume. *Roll* is Roll's liquidity measure constructed by following Bao, Pan and Wang (2011). D_{age} is a dummy variable that equals one if the bond is more than two years old and zero otherwise. *LT-holdings* refer to long-term institutional investors' holdings. *Rating*, *Coupon*, *Security*, *Size*, *Maturity*, *Covenant*, $D_{covenant}$, are defined in Table 1. *AMH_lag*, *AMH_lag_missing*, *Volume_lag*, *Volume_lag_missing*, *Roll_lag*, and *Roll_lag_missing* are the one-month lagged variables *AMH*, *AMH_missing*, *Volume*, *Volume_missing*, *Roll*, and *Roll_missing*, respectively. The t-statistics are reported in brackets. We control for firm and year fixed effects. The standard errors are clustered by year and firm. ***, **, and * represent statistical significance at 1%, 5% and 10%, respectively.

	Dependent Variable:					
	AMH	AMH	Volume	Volume	Roll	Roll
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
D_{age}	0.0005	0.0007	-0.1523**	0.3533***	0.6444**	0.0955
	(1.18)	(1.05)	(-2.48)	(4.25)	(2.43)	(0.26)
D_{age}×LT_Holdings		-0.0002		-0.5342***		0.5702*
		(-0.45)		(-8.47)		(1.66)
Rating	-0.0002	-0.0002	0.0179	0.0204	0.1229**	0.1191**
	(-1.00)	(-0.99)	(1.15)	(1.39)	(1.98)	(1.97)
D_{age}×Rating	-0.0001	-0.0001	-0.0091	-0.0166	0.0050	0.0150
	(-1.02)	(-1.02)	(-0.85)	(-1.60)	(0.11)	(0.35)
Coupon	-0.0001	-0.0001	-0.1360***	-0.1345***	0.0992***	0.0940***
	(-0.80)	(-0.82)	(-7.18)	(-7.20)	(2.74)	(2.60)
Security	-0.0001*	-0.0001*	0.0203	0.0268	0.0253	0.0192
	(-1.77)	(-1.76)	(1.12)	(1.47)	(0.50)	(0.38)
Size	0.0001	0.0001	0.3780***	0.3928***	-0.3728***	-0.3612***
	(0.79)	(0.79)	(13.01)	(13.57)	(-7.88)	(-7.24)
Maturity	0.0003*	0.0003*	0.0883***	0.0920***	0.9931***	0.9884***
	(1.90)	(1.88)	(5.01)	(5.21)	(21.64)	(21.38)
Covenant	-0.0028	-0.0031	0.1267	0.1877	0.7867	0.7484
	(-0.54)	(-0.57)	(0.53)	(0.78)	(1.14)	(1.09)
$D_{covenant}$	0.0011	0.0011	-0.1804***	-0.1842***	-0.2083	-0.1915
	(0.97)	(0.99)	(-2.69)	(-2.77)	(-1.14)	(-1.05)
AMH_lag	0.0000	0.0000				
	(0.81)	(0.80)				
AMH_lag_missing	0.0018	0.0018				
	(1.27)	(1.27)				
Volume_lag			0.3709***	0.3634***		
			(28.89)	(28.98)		
Volume_lag_missing			5.5822***	5.4587***		
			(29.85)	(29.83)		
Roll_lag					0.0710***	0.0707***
					(2.68)	(2.62)
Roll_lag_missing					1.2773***	1.2674***
					(11.34)	(11.22)
Constant	-0.0013	-0.0013	7.9402***	7.9104***	-2.8486***	-2.8375***
	(-1.16)	(-1.15)	(24.26)	(24.85)	(-4.68)	(-4.75)
N	66816	66030	68373	67323	35693	35509
Adj. R^2	0.01	0.01	0.33	0.33	0.23	0.23

Table 10. Learning and Expected Returns

This table tests the relation between bond seasoning and expected returns. The bond data sample spans from 1998Q1 to 2007Q2. The dependent variables are the expected returns of the bonds, $Return_e$, which are proxied by the realized return in the next month minus the risk-free rate. D_{age} is a dummy variable that equals one if the bond is more than two years old and zero otherwise. *LT-holdings* refer to long-term institutional investors' holdings. *Rating*, *Coupon*, *Security*, *Size*, *Maturity*, *Covenant*, $D_{covenant}$, *AMH*, *AMH_missing*, *Volume*, *Roll*, and *Roll_missing* are defined in Table 1. The t-statistics are reported in brackets. We control for firm and year fixed effects. The standard errors are clustered by year and firm. ***, **, and * represent statistical significance at 1%, 5% and 10%, respectively.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
D_{age}	-0.0010	0.0030*	-0.0010	0.0030*	-0.0012	0.0029
	(-0.76)	(1.67)	(-0.80)	(1.69)	(-0.90)	(1.64)
D_{age}×LT_Holdings		-0.0042***		-0.0043***		-0.0043***
		(-2.63)		(-2.70)		(-2.71)
Rating	0.0008**	0.0008**	0.0008**	0.0008**	0.0008**	0.0008**
	(2.11)	(2.35)	(2.11)	(2.35)	(2.10)	(2.35)
D_{age}×Rating	0.0004**	0.0004*	0.0004**	0.0004*	0.0004**	0.0004*
	(2.13)	(1.95)	(2.14)	(1.95)	(2.12)	(1.93)
Coupon	-0.0007***	-0.0007***	-0.0007***	-0.0007***	-0.0007***	-0.0007***
	(-4.86)	(-4.64)	(-4.97)	(-4.81)	(-5.01)	(-4.78)
Security	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001
	(0.12)	(0.42)	(0.13)	(0.45)	(0.31)	(0.63)
Size	-0.0010***	-0.0011***	-0.0009***	-0.0010***	-0.0008***	-0.0009***
	(-5.05)	(-5.69)	(-4.60)	(-5.07)	(-4.11)	(-4.73)
Maturity	0.0005**	0.0005**	0.0005***	0.0005***	0.0004**	0.0004**
	(2.54)	(2.57)	(2.66)	(2.72)	(2.04)	(2.08)
Covenant	-0.0004	0.0000	-0.0003	0.0001	-0.0004	-0.0000
	(-0.12)	(0.00)	(-0.09)	(0.03)	(-0.13)	(-0.01)
$D_{covenant}$	-0.0006	-0.0006	-0.0006	-0.0006	-0.0005	-0.0005
	(-0.80)	(-0.77)	(-0.87)	(-0.86)	(-0.71)	(-0.68)
AMH	0.0000	0.0000				
	(1.30)	(1.29)				
AMH_missing	0.0013	0.0019				
	(0.53)	(0.70)				
Volume			-0.0001	-0.0001		
			(-1.14)	(-1.57)		
Roll					0.0001	0.0001
					(1.39)	(1.31)
Roll_missing					0.0021***	0.0021***
					(4.94)	(4.97)
Constant	-0.0004	-0.0003	0.0010	0.0016	-0.0021	-0.0021
	(-0.15)	(-0.13)	(0.42)	(0.64)	(-0.84)	(-0.85)
N	61814	61229	61814	61229	61814	61229
Adj. R^2	0.08	0.08	0.08	0.08	0.08	0.08

Appendix A: The Definitions of Key Variables

Variable Names		Definitions
Holding Concentration	=	The squared ratio of the average of the percentage holding by each institution divided by the total institutional holding of a particular bond. Institutional holding is the total amount of institutional ownership recorded in the Emaxx database divided by the outstanding amount of the bond issue in Mergent FISD.
$Return_e$	=	The expected return of the bond at the current quarter end, which is proxied by the realized return in the next month minus the risk-free rate from NAIC and TRACE
Short-term Concentration	=	The squared concentration ratio by short-term investors only. Short-term investors include holdings by annuities/variable annuities, finance companies, hedge funds, investment managers and mutual funds.
Short-term Holdings	=	The ratio of short-term investors divided by the total institutional holdings recorded in Emaxx.
Long-term Holdings	=	The ratio of long-term investors (the remaining institutional investors) divided by the total institutional holdings recorded in Emaxx.
DiffLearn1	=	The credit rating dispersion among the three major credit rating agencies, Moody's, Standard & Poor's, and Fitch, and is computed as the standard deviation of the credit ratings from the three rating agencies. The credit ratings are converted into a categorical scale from 1 to 21 for the ratings AAA to C equivalent. If one of the three agencies' ratings is not available, we use the difference between the remaining two ratings. The rating data are obtained from Mergent FISD.
DiffLearn2	=	Dummy variable that equals one if the bond is the first issue of the firm and zero otherwise.
DiffLearn3	=	Dummy variable that equals one if the bond belongs to a firm that is in the bottom 30th percentile of all firms in terms of the number of bonds outstanding and zero otherwise.
DiffLearn4	=	Dummy variable that equals one if the bond belongs to a firm that is in the bottom 30th percentile of all firms in terms of the total dollar outstanding amount of bonds and zero otherwise.
D_{age}	=	Dummy variable that equals one if the bond is more than two years old and zero otherwise.
$D1_{age}$	=	Dummy variable that equals one if the bond is more than two and less than five years old and zero otherwise.
$D2_{age}$	=	Dummy variable that equals one if the bond is more than five years old and zero otherwise.
Age	=	The natural logarithm of the age of the bond.
Rating	=	The numerical scale of the credit ratings, ranging from 1 to 21 where AAA equals to 1, AA equals to 2, and etc.
Coupon	=	The coupon rate of the bond in percentage
Security	=	A categorical variable that equals one if it is a senior secured bond, two if it is a senior bond, three if it is a senior subordinated bond, four if it is a junior bond, five if it is a junior subordinated bond, six if it is a subordinated bond and seven otherwise.
Size	=	The natural logarithm of the total amount outstanding of the bond in thousands.
Maturity	=	The natural logarithm of the number of months to maturity of the bond
Covenant	=	The covenant index constructed by following Billett, King and Mauer (2007).
$D_{covenant}$	=	Dummy variable that equals one if any of the covenant indexes is not zero.
AMH	=	The Amihud liquidity measure, which is constructed following Lin, Wang and Wu (2011).
Volume	=	The natural logarithm of the total trading volume

Roll	=	Roll's liquidity measure constructed following Bao, Pan and Wang (2011).
AMH_missing	=	Dummy variable that equals one if *AMH* is missing and zero otherwise. Volume is the natural logarithm of the total trading volume
Volume_missing	=	Dummy variable that equals one if *Volume* is missing and zero otherwise. Roll is Roll's liquidity measure constructed following Bao, Pan and Wang (2011).
Roll_missing	=	Dummy variable that equals one if *Roll* is missing and zero otherwise. The t-statistics are reported in brackets. The standard errors are clustered by year and firm.
$TSCS_1$	=	Dummy variable that equals 1 if the term structure of credit risk proxied by the monthly absolute percentage change of credit spread between the 20-year Constant Treasury yield and the 1-year Constant Treasury yield is in the top 50 percentile during the sample period.
$TSCS_2$	=	Dummy variable that equals 1 if the term structure of credit risk proxied by the monthly absolute percentage change of credit spread between the 20-year Constant Treasury yield and the 5-year Constant Treasury yield is in the top 50 percentile during the sample period.
MIN_TONE(IND+MACRO)*	=	The interaction of the minimum of the positive or negative tone in each credit rating report defined in Loughran and McDonald (2011) and the proportion of sentences that fall into "Industry" and "Macroeconomics" categories defined in Agarwal, Chen and Zhang (2015).
FOG(IND+MACRO)*	=	The interaction of report complexity measure FOG index defined in Gunning (1952) and the proportion of sentences that fall into "Industry" and "Macroeconomics" categories.