Kicking Maturity Down the Road:

Early Refinancing and Maturity Management in the Corporate Bond Market

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Abstract

This paper studies debt maturity management through early refinancing, in which firms simultaneously retire their outstanding bonds before the due date and issue new bonds as replacements. Speculative-grade firms frequently refinance early to extend the maturity of their outstanding bonds, particularly under accommodating credit supply conditions. I exploit the timing of the protection period of callable bonds to show the maturity extension is not driven by unobservable firm characteristics or interest-rate conditions. The evidence is consistent with precautionary maturity management, where speculative-grade firms extend maturity to hedge against refinancing risk caused by credit supply fluctuations. Investment-grade firms do not manage their maturity similarly as they are less exposed to refinancing risk.

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1 Introduction

In a frictionless Modigliani and Miller [1958] setting, the maturity structure of debt does not affect firms' value. Firms can simply refinance at the due date and roll over the debt. In reality, the timing of the due date can be crucial. Firms refinancing during credit market downturns might have to pay significantly higher rates, sell assets in a fire sale, reduce investment, etc.. [1] While CFOs constantly claim they manage debt maturity to "reduce risk of having to borrow in bad times"(Graham and Harvey [2001]), there is very little evidence about how they do this or about which firms see this as a first order concern.

In this paper, I examine how firms manage debt maturity through early refinancing, in which firms simultaneously retire their outstanding bonds before the scheduled due date and issue new bonds as replacements. Early refinancing is a common practice that involves hundreds of billions of dollars each year in the corporate bond market. Previous studies mainly attribute early refinancing to firms' desire to reduce interest expenses: for example, firms retire their outstanding bonds and issue new ones at cheaper rates when credit supply conditions are good. In contrast, I identify a number of patterns that suggest speculative-grade firms frequently refinance early to extend debt maturity, in order to avoid having to issue when credit supply conditions are bad.

First, the majority of speculative-grade firms' bonds are refinanced before their due date. When refinancing early, speculative-grade firms issue new bonds with longer maturities to extend the maturity structure. In contrast, only a small fraction of investment-grade firms' bonds are refinanced early. When investment-grade firms refinance early, they replace expensive bonds with cheaper bonds of similar maturity. Early refinancing does not change the maturity structure of investment-grade firms.

Second, aggregate credit supply conditions dictate early refinancing of bonds and hence the maturity structure of debt. Speculative-grade firms take advantage of favorable credit market conditions to refinance early on a large scale, resulting in a procyclical debt maturity structure. They refi-

[1] Acharya et al. [2011], Froot et al. [1993], Brunnermeier and Yogo [2009], Choi et al. [2013], Almeida et al. [2012], Leland [1996], He and Xiong [2012]

nance early 10%–15% of total outstanding bonds during good credit periods, such as 2004–2005 and 2010-2011, but only about 2% during credit market downturns. The maturity structure moves closely with early refinancing for speculative-grade firms—it extends significantly when firms substantially refinance early, and shortens when early refinancing dries up. Investment-grade firms, in contrast, refinance early only 1%–2% of total outstanding bonds even during good credit periods. Their maturity structure is insensitive to early refinancing.

Third, those early refinancing activities can not be explained solely by interest rate reductions. About half of the early refinancing activities are conducted through tender offers and repurchases. Firms need to pay at least the market prices in repurchases, and typically plus some premium in tender offers, to induce bond holders to comply. Purchasing outstanding bonds at market prices or higher cannot save interest payments for firms.

I interpret the results through the lens of *precautionary maturity management*. Refinancing during credit market downturns, when credit is expensive or unavailable, can be costly. Refinancing risk motivates *precautionary maturity management*, where forward-looking speculative-grade firms frequently "kick maturity down the road," particularly during favorable credit periods. The longer maturity structure reduces the possibility of being forced to refinance during credit market downturns, hence hedges against refinancing risk caused by credit supply fluctuations.

Two factors expose speculative-grade firms to greater refinancing risk, driving them to conduct more precautionary maturity management. First, changing credit supply conditions disproportionately affect the financing costs of speculative-grade firms. While financing costs remain relatively stable for investment-grade firms over a credit cycle, they increase sharply for speculative-grade firms during credit market downturns. Second, speculative-grade firms rarely issue bonds longer than ten years, which suggests a credit supply constraint on maturity at which they can issue. This constraint leads to significant maturity mismatch between the assets and liabilities of speculative-grade firms, forcing them to frequently tap the capital markets for refinancing. To mitigate refinancing risk, speculative-grade firms synthesize long-term bonds via early refinancing when credit supply conditions are favorable. Investment-grade firms do not manage their maturity in the same way as they are less exposed to refinancing risk.

I test the precautionary maturity management hypothesis by first establishing the causal impact of early refinancing on maturity extension. The task is difficult because of firms' endogenous choice of early refinancing and maturity. For example, firms that choose to refinance early might desire different maturity because of the changes in firm fundamentals or market interest rate conditions. Within-firm analysis suffers from dynamic versions of the similar endogeneity concerns. Omitted variables can bias the OLS estimates of the impact of early refinancing on maturity to either direction.

As an identification strategy, I exploit variation in the callable structure of corporate bonds. Firms commonly embed call provisions when issuing bonds, entitling them to call bonds during a defined period at prespecified prices. Call provisions have two important features. First, they make early refinancing easier for firms. Bond holders have to return the bonds when firms call. Also, when lower interest rates are available, firms may transfer the value from bond holders to themselves by exercising the call, which makes calls a subsidized way to refinance early. Second, a call provision comes with a protection period, defined as the period during which a firm cannot call the bond. This provides bond holders with a guaranteed length of time during which they will be able to hold the bonds and receive promised coupon payments. The standard practice is to set the protection period to last 50% of maturity at issuance: for example, a 10-year bond normally has a 5-year protection period. The fact that protection periods are standard in length and decided upon well in advance creates essentially exogenous variation in the ease of early refinancing.

I instrument firms' early refinancing activities with a dummy variable indicating whether a firm's bonds are scheduled to pass the protection period and become callable in a given firm-year. Identification requires that the timing of when bonds become callable is uncorrelated with current unobservable factors that make firms demand longer maturity. The lengthy and standard protection period plays a key role in this identification strategy, as it is unlikely that future movements of the unobservables, such as investment opportunities or the yield curve, would coincide with when bonds become callable. In terms of the estimates, for speculative-grade firms, a one–standard–

deviation (30%) increase in the probability of early refinancing leads to a more than 10% increase in the fraction of book debt with maturity $\geq$5 years, and to more than a one year extension in the average maturity for outstanding bonds. In contrast, investment-grade firms do not extend maturity through early refinancing.

After establishing the causal relationship between early refinancing and maturity extension, I test the precautionary maturity management hypothesis with more predictions. Firms that are more exposed to refinancing risk should have a greater incentive to manage maturity in advance. I test this intuition in two ways. First, I group speculative-grade firms based on the degree of maturity mismatch between their assets and liabilities. Given that we do not directly observe the maturity of firms' assets, I use investment-grade firms in the same industry as a benchmark, assuming they are able to issue longer bonds that better match the maturity of their assets and liabilities. I rank industries based on the difference in maturity at issuance between the investment-grade and speculative-grade bonds. Speculative-grade firms in industries with greater maturity mismatch do extend maturity more via early refinancing.

Second, I study the timing and bond selection of firms' early refinancing activities. Speculative-grade firms rarely wait until the due date to refinance their bonds. For these firms, less than 10% of the refinancing happens around the scheduled due date, whereas the fraction is over 70% for investment-grade firms. When refinancing early, speculative-grade firms tend to replace bonds with shorter maturity, but do not pay much attention to the yield-to-maturity of their bonds. Investment-grade firms behave in the opposite way: they target more expensive bonds, but do not take the maturity dimension into account.

This paper contributes to the literature in a number of ways. First, it adds a new dimension to the early refinancing of corporate bonds. Researchers mainly attribute early refinancing to firms' desire to reduce interest payments: when yields drop, firms retire their outstanding bonds and issue new ones at the less expensive prevailing rate (Merton [1974], Brennan and Schwartz [1977], Vu [1986], Mauer [1993], Longstaff and Tuckman [1994], Acharya and Carpenter [2002], Jarrow et al. [2010]). This paper shows that, particularly for speculative-grade firms, early refinancing also helps to manage debt maturity. It serves to reduce refinancing risk (He and Xiong [2012]) together with the choice of maturity at issuance (Brunnermeier and Yogo [2009], Choi et al. [2013]) and other liquidity holdings such as cash and credit lines (Harford et al. [2014]).

Second, this paper adds a dynamic perspective to the debt maturity literature. Most previous studies on corporate debt maturity focus on the cross-sectional relationship between firms' characteristics and corporate debt maturity (Diamond [1991, 1993], Barclay and Smith [1995], Rajan and Winton [1995], Guedes and Opler [1996], Diamond and Rajan [2001], Johnson [2003], Berger et al. [2005], Benmelech [2008]). In many leading models, maturity is treated as a stationary process, whereby firms commit to a stationary maturity structure (Leland and Toft [1996], He and Xiong [2012]). While a few papers study how interest rate conditions and business cycles affect the maturity choice *at issuance* (Baker et al. [2003], Graham and Harvey [2001] and Chen et al. [2012]), this paper emphasizes the *post issuance* dynamics of maturity and the important roles that early refinancing and credit supply conditions play in it. It also highlights that firms across rating segments manage their maturity very differently, and suggests the importance of studying the impact of ex-post refinancing on the ex-ante choice of maturity at issuance.

Third, this paper is also related to several studies demonstrating that capital market segmentation and credit supply conditions significantly influence observed financial structure and corporate behavior (Faulkender and Petersen [2006], Leary [2009], Sufi [2009b], Tang [2009], Lemmon and Roberts [2010], Chernenko and Sunderam [2012], Erel et al. [2012]). These studies differ from much of the existing capital structure literature, where capital supply is assumed to be perfectly elastic and capital structures are determined solely by corporate demand for debt. I add to this line of research by showing that the effect of credit supply conditions disproportionally impacts speculative-grade firms, and maturity is an important channel.

A closely related empirical paper is Mian and Santos [2011], who show that creditworthy firms try to actively manage the maturity of syndicated loans in normal times. Liquidity demand then becomes countercyclical for these firms because they choose not to refinance when liquidity costs rise. In contrast, my paper shows that weaker firms are those that display a procyclical pattern in early refinancing and maturity extension in the corporate bond market.

The remainder of the paper proceeds as follows: Section 2 describes the data and summarizes early refinancing activities and contract term changes through early refinancing. Section 3 estimates the causal impact of early refinancing on maturity extension by exploiting the callable structure of corporate bonds. Section 4 provides more supportive evidence for precautionary maturity management hypothesis. Section 5 discusses the relation between precautionary maturity management and firms' liquidity holdings. Section 6 concludes.

2 Data and Early Refinancing Summary Statistics

2.1 Data

The Mergent Fixed Income Securities Database (FISD) is a comprehensive database of publicly offered US bonds. FISD includes the majority of corporate bonds and provides details on bond issuance and the issuers. Beginning in April 1995, FISD began tracking changes in the outstanding amount of publicly traded corporate bonds. Thus, in addition to the characteristics of the bonds at issuance, FISD contains a detailed history of changes in the amount of bonds outstanding. FISD records the actions,[2] the effective dates of the changes in the amount of bonds outstanding, the exact amount changed, and the remaining principal balance afterwards.

I merge the FISD data with other information from Compustat, Capital IQ, and Bloomberg.[3] The final data set contains information on bonds outstanding for a firm in a given fiscal year, including bond characteristics and contract terms at issuance, yield-to-maturity, type and dollar amount of actions taken for the outstanding bonds, and the principal amount remaining after these actions. To be included in the sample, a firm has to have at least three consecutive annual observations with public bonds outstanding. The final sample includes 1,497 nonfinancial US firms and 15,196 fiscal

[2] Actions, such as calls, tender offers, etc., are defined in Appendix Section A.

[3] Ownership of a bond changes following mergers or acquisitions. The information provided in the issuer notes from FISD, as well as the Thomson M&A database, is used to identify the precise effective dates of ownership changes.

year observations starting in 1996. The sample covers 31,640 bonds. From the Federal Reserve, I obtained the BAA-AAA spread, constant maturity Treasury rates, and effective yields on different rating indexes.

In Panel (a) of Table 1, I compare sample firms with all non-financial firms in the Compustat database during the same time period (1996–2011).[4] Relative to the average Compustat firm, sample firms tend to be larger, more profitable, have higher leverage, and are more likely to have an S&P long-term issuer credit rating. These differences are not surprising given that sample firms can issue corporate bonds. Panel (b) presents sample firm distribution across industries.[5] Although non-uniform, it is quite representative of the overall Compustat distribution. Business equipment and healthcare industries have higher percentages in the Compustat sample, whereas the manufacturing industry has a relatively larger composition in the sample data. Comparing the distribution more broadly, there are similar percentages overall, particularly in consumer products and wholesale, retail, & some services. Panel (c) reports summary statistics for 31,640 sample bonds.[6] The median offering amount is \$100 million, with an average of \$224 million. Maturity at issuance has a mean of 10.3 years, with an average coupon rate of 6.60%. Thirty percent of the bonds are rated as speculative-grade at issuance. Almost all bonds have covenants associated with them; the average covenant count is about 4.15.[7]

2.2 Early Refinancing Activities Summary

I define refinancing to have occurred if within a three-month time window centered on the month a bond is retired, firms issue other bonds with a dollar amount comparable to the retired amount. Early refinancing refers to the cases in which refinancing happens at least six months before the scheduled due date. Table 2 Panel (a) summarizes the dollar amount of early refinancing, maturing,

[4]To mitigate the impact of outliers and the possible coding errors, I winsorize all ratios at the upper and lower one percentiles, and apply the winsorization to all the analysis in this paper. All variables are defined in Appendix Section B.

[5]I obtained 12 industry definitions from the Fama French data library, which is available at http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

[6]Contract terms are defined in Appendix Section C.

[7]Covenant terms are defined in Appendix Section D.

and total outstanding bonds for sample firms. The total dollar amount of outstanding sample bonds grew from approximately $600 billion in 1996 to roughly $2,400 billion in 2011. The maturing amount trends similarly to the total outstanding amount of sample bonds.

The early refinancing amount is much more volatile: years such as 2000 and 2008 show sharp decreases followed by large rebounds. early refinancing declines sharply in 2000 and 2008, coinciding with the two financial market crashes of the last decade. Early refinancing activities peak in 1998, 2004–2005, and around 2010. The procyclical pattern in early refinancing is even stronger for the speculative-grade firms. As shown in Figure 1 panel (a), speculative-grade firms early refinance 10%–15% of total outstanding bonds during good credit periods, such as 2004 and 2010, but less than 2% during credit market downturns. Speculative-grade firms display a strong procyclical pattern in their early refinancing activities. In contrast, investment-grade firms consistently refinance early only 1%–2% of total outstanding bonds.

In Figure 2, I decompose early refinancing based on methods of redemption. Calls, whereby issuers exercise call provisions to buy back outstanding bonds, are a common method of early refinancing. Tender offers account for the majority of the rest. In 2003–2004, firms called about $30 billion of outstanding corporate bonds, whereas the total amount of early refinancing was around $60 billion. Also, the plot shows the very familiar procyclical fluctuation: call amounts increase sharply in 1998, 2003–2004, and 2010–2011, and decrease during two market downturns in the previous decade. The procyclical call amounts are thus one factor behind the procyclical aggregate early refinancing activity.

Early refinancing conducted through tender offers, repurchases, and make-whole calls cannot be explained by interest rate reductions. Firms need to pay at least the market prices in repurchases, and typically plus some premium in tender offers, to induce bond holders to comply. A make-whole call is even more expensive because all the future coupons have to be paid at a discount rate close to the Treasury rate.

2.3 Early Refinancing and Maturity Extension

For every early refinancing case, I match the early-retired bond to the newly-issued bond and examine the differences. The tests are presented separately for the investment-grade and speculative-grade firms in Table 2 panel (b). The table presents a new fact: speculative-grade firms get a significant extension in maturity, whereas investment-grade firms simply issue new bonds with a similar maturity. Speculative-grade firms extend maturity from 3.91 years to 8.79 years. Investment-grade firms' maturity moves from 11.5 years to about 12.5 years, which is statistically indistinguishable. Speculative-grade firms do not appear to adjust the maturity which they issue at, because the retired bonds and the new bonds have maturity at issuance of 8.6 and 8.8 years. Investment-grade firms shorten the maturity at issuance from 18.55 years to about 13 years.

Table 2 panel (b) also shows that both types of early refinancers obtain lower interest payments, which is consistent with the existing literature on early refinancing. The coupon rate decreases 1.18% for speculative-grade firms, and 1.89% for investment-grade firms. For covenant strictness, speculative-grade firms get a drop of about one covenant through early refinancing: the covenant count decreases from 6.97 to 6.03. Investment-grade firms experience a drop in covenant count from 3.45 to 3.26 . There are no significant changes in the covenant dummy.

Maturity extension through early refinancing, along with the procyclical early refinancing activities of speculative-grade firms, explains the time–series correlation between early refinancing and firms' maturity structures in Figure 1 panel (b). Speculative-grade firms' maturity structures extend significantly when they conduct early refinancing on a large scale in 2004 and 2010. When speculative-grade firms' early refinancing activities drop sharply in years such as 2000 and 2008, their maturity structure shortens correspondingly, leading to the procyclical maturity structure. A similar correlation between early refinancing and firms' maturity structure for investment-grade firms is not found.

3 Precautionary Maturity Management: Identification

3.1 Identification Goal and Challenge

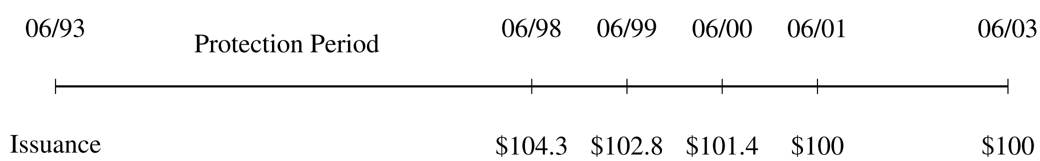
The biggest empirical challenge for the precautionary maturity management hypothesis is to prove the causal relationship between early refinancing and maturity extension. Although the descriptive statistics show the correlation between speculative-grade firms' early refinancing activities and maturity extension, estimating the causal impact remains difficult. The ideal experiment is to randomly assign speculative-grade firms the opportunity to refinance early. If speculative-grade firms want to extend maturity by early refinancing, firms with a randomly assigned opportunity are expected to extend maturity by a larger magnitude than firms without it. Given that we do not have the ideal experiment setting, the challenge for the estimation comes from endogeneity concerns. For example, if firms with stronger fundamentals are more likely to refinance early and better firms tend to issue longer bonds, then we would observe the positive correlation between early refinancing and maturity in the cross-section.

Within-firm analysis suffers from dynamic versions of the same endogeneity concerns. Firms are choosing when to refinance early and which maturity to issue at simultaneously. For example, a firm might choose to refinance early when its fundamental improves and the better fundamental allows it to issue longer bonds. Then the positive correlation between early refinancing and maturity extension within the firm is indeed driven by its fundamental changes. Or a firm might choose to refinance early when there are new projects coming up and it prefers to issue the new bonds according to the length of the new projects. Longer projects will lead to a positive correlation between early refinancing and maturity and vise versa. It's also likely that when a firm chooses to refinance early, the yield curve might happen to be downward-sloping and the firm would prefer to issue at longer maturity because long-term interest rates are low compared to short-term rates. These omitted variables can bias the estimates of the impact of early refinancing on maturity in a within-firm analysis.

To estimate the causal impact of early refinancing on maturity extension, we need a shock to early refinancing opportunity, which is not plagued by the unobservables driving firms' demand for different maturity. I use the protection period setting of the call provision to generate a shock to early refinancing opportunity, which is uncorrelated with the contemporaneous confounding factors.

3.2 Institutional Background: Call Provision and Protection Period

Firms commonly pay a higher yield to embed call provisions when issuing bonds. If a call provision is included at issuance, the call schedule, call prices, and protection period are contracted. The protection period is the period during which the company cannot call the bond, starting from the issuing date. It provides the bond holders with a guaranteed length of time for which they will be able to hold the bond and receive coupon payments. For example, Kroger issued a callable 10-year senior debenture on June 15, 1993, with the scheduled due date on June 15, 2003. The embedded call provision states that Kroger would be able to call the debenture starting June 15, 1998, five years after the issuance day, with a price of $104.25. The call price decreased to $102.834 on June 15 1999, to $101.417 on June 15, 2000, and finally to $100 on June 15, 2001. The 5-year protection period is 50% of maturity at issuance. In my sample, 89.4% of speculative-grade firms' bonds have call provisions. The protection period setting is fairly standard: a 10-year bond typically has a 5-year protection period, whereas a 7-year bond typically has a 3.5-year protection period.



Call Schedule for Kroger 10-Year Senior Debenture

Call provisions are advantageous tools for early refinancing. First, they facilitate early refinancing because bond holders have to return the bonds upon calling. In tender offers and repurchases, bond holders retain the right to not respond. Second, when a lower interest rate is available, either because of a drop in the prevailing market rate or because of better firm performance, the value of an outstanding bond increases correspondingly. If the discounted value exceeds contemporaneous scheduled call prices, firms transfer values from bond holders to themselves by calling outstanding bonds at scheduled prices. The value transferred essentially makes calls a subsidized way to refinance early. However, if a bond is not yet callable because of the protection period, the firm can only conduct early refinancing through tender offers, repurchases, or make-whole calls.

3.3 Instrumental Variable Strategy: Timing of the Protection Period

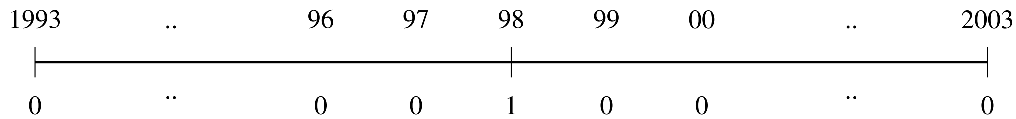
My instrumental variable strategy exploits the timing of the protection period. I instrument early refinancing activities with a dummy variable indicating that some bonds are scheduled to become callable for firm i in year t. The intuition is that bonds turning callable facilitate early refinancing, because protection periods are fairly standard in length and decided upon well in advance, the shock is disconnected from unobservable determinants of maturity.

Consider two otherwise identical firms, A and B, that both issued a 10-year bond with a 5-year protection period. Firm A issued the bond five years ago, and the protection period ends in year t. Firm B issued the bond three years ago and the protection period is not yet over. In year t, the timing of the protection period puts firm A in a better position to refinance its outstanding bonds and extend maturity. Firm B is constrained in its ability to refinance early because the outstanding 10-year bond is not yet callable. Although firm B can use other methods, such as tender offers or repurchases, those methods might not be as desirable.

The following is the IV strategy 1 specification:

$$Maturity_{i,t} = \delta_0 + \delta_1 \widehat{D(Early\_refi)}_{i,t} + \delta_i controls_{i,t} + \varepsilon_{it} \qquad 2nd\ stage$$

$$D(Early\_refi)_{i,t} = \beta_0 + \beta_1 D(turn\_callable)_{i,t} + \beta_i controls_{i,t} + e_{i,t} \qquad 1st\ stage$$



Turn Callable Indicator for Kroger 10-year Senior Debenture

Here, $D(turn\_callable)$ equals one if some outstanding bonds are scheduled to pass the protection period and become callable for firm i at year t. Take the Kroger 10-year senior debenture as an example. The turn-callable indicator for this debenture switches to one in 1998, and remains zero for all the other years, leading to $D(turn\_callable) = 1$ for Kroger in year 1998. Early refinancing activity is indexed by $D(Early\_refi)$, a dummy equals one if firm i refinances early at year t. The exclusion restriction requires that the instrument $D(turn\_callable)_{i,t}$ only relates to the outcome variable $Maturity_{i,t}$ through its effect on early refinancing. The identification assumption is that the timing of some bonds scheduled to become callable is uncorrelated with current unobservables that might lead firms to adjust maturity. Protection periods are fairly standard in length and decided upon well in advance. Therefore, future movements of the unobservables, such as the investment opportunities or the term structure, are unlikely to coincide with the timing of the call schedule.

Firm characteristics and interest rate conditions are controlled in the regressions. Firm characteristic controls include Ln(Assets), book leverage, EBITDA/Assets, Cash/Assets, Tangible/Assets, Market/Book, and S&P rating. Ln(Assets) measures a firm's ability to collateralize the debt and also captures the liquidation value in a distressed state. Leverage captures a firm's financial health. Market/Book is used to measure future investment prospects. EBITDA/Assets and Cash/Assets measure a firm's profitability and short-term liquidity. Tangible/Assets measures the pledgeability of assets. I include the S&P rating as a general control for a firm's default risk. Interest rate controls include the risk-free rate (3-month T-bill), term spread (10-year corporate bond yield minus 1-year corporate bond yield), and BAA-AAA credit spread. To control for time-unvarying unobservables that might also affect a given firm's maturity choice, I include firm fixed-effects. Year fixed-effects are included to control for time-series unobservables that affect all firms' maturity choice.

3.4 Instrumental Variable Strategy: Results

Table 3 presents the IV regression first-stage results. I use two measures to capture early refinancing activities: the first one is a dummy D(Early-refi) indicating whether firm i conducted early refinancing activities in year t; the second one is F(Early-refi), which measures the fraction of the total amount of outstanding bonds undergoing early refinancing for firm i in year t. I also use two variables to measure firms' maturity structure: the fraction of total book debt with maturity $\geq$5 years, which captures the overall maturity structure of firms' book debt, and the average bond maturity, which measures the maturity structure of corporate bonds. In panel (a), the first-stage shows strong results for both indexes of early refinancing activities. In terms of economic magnitudes, the dummy indicating some bonds becoming callable increases the probability of early refinancing by 7.9% and the fraction of early refinancing by 2.3%. In panel (b), the instrument is strongly correlated with both maturity measurements in reduced-form regressions after controlling for other firm characteristic and interest rate variables.

Table 3 panel (a) shows the regression results with $F(debt \geq 5Y)$ as the outcome variable, and panel (b) shows the regression results with average bond maturity as the outcome variable. Both tables present the estimates from the OLS regressions (column 1 without firm characteristic controls and column 2 with firm characteristic controls), and the IV regressions (column 3 without firm characteristic controls and column 4 with firm characteristic controls) with D(Early-refi) as the instrumented variable. OLS estimates are positive, and adding firm characteristics appears to have little effect on the coefficients of early refinancing. In IV regressions, the Kleibergen-Paap Wald F-stat for the weak instrument test is much larger than ten, which is the rule of thumb for identifying a weak instrument. IV regressions show early refinancing leading to a larger fraction of book debt with maturity $\geq$5 years, as well as a longer average bond maturity. In terms of economic magnitudes, the estimates indicate that a one–standard–deviation (30%) increase in the probability of early refinancing leads to a 10.4% increase in the fraction of book debt with maturity $\geq$5 years and a 1.3 year extension of average bond maturity. Including firm characteristic controls has little impact on the IV estimates, indicating that the instrumental variable is not correlated with the observable firm characteristics.

There are a few possible explanations for IV estimates being larger than the OLS estimates in Table 3. First, when a firm chooses to refinance early, it might have short-term projects coming up or face a steeper yield curve because short-term interest rates are low compared to long-term rates. That would result in firms' demand for short-term maturity, leading to a downward bias in the OLS coefficients. Second, IV regressions estimate the local average treatment effect (LATE) on firms responding to the shock, whereas OLS regressions estimate the average treatment effect (ATE) for all sample firms. Firms that respond to the instrument are more likely to be eager for maturity extension, leading to a stronger effect of early refinancing on maturity.

3.5 Instrumental Variable Strategy: Robustness

The identification strategy requires that the timing of some bonds scheduled to become callable is uncorrelated with current unobservables that might lead firms to adjust maturity. I conduct a few robustness checks to test the validity of the identification assumption.

First, there might be concerns regarding the endogenous choice to embed call provisions at issuance. Firms with certain characteristics might be more likely to choose call provisions, refinance early and adjust maturity. However, in the speculative-grade sample, the vast majority (89.4%) of bonds contain call provisions at issuance. The variations in terms of the choice of call provisions at issuance are indeed small. I also tabulate firm-year observations by the choice of call provisions. Appendix Table 1 presents a summary for these two groups and two sample t-tests. Most measures including the leverage, Market/Book ratio, the profitability, the liquidity position, growth opportunities, and the K-Z index are similar between firm-years issuing bonds with or without call provisions.

Second, there might be concerns regarding the endogenous choice of protection period: firms might foresee the future movements in firm fundamentals or market interest rates and set the protection period to coincide with their projection. The protection-period setting is indeed fairly standard with small variations. In the speculative-grade sample, the average protection period is 49.7 months, with a standard deviation of 11.2 months. The protection period ratio on average is 48% of maturity at issuance, with a standard deviation of only 6.6%.

Also, I regress the protection–period setting on various bond characteristics, firm characteristics at issuance, and interest rate controls at issuance. The dependent variable is the ratio of the protection period to maturity at issuance. For example, if maturity at issuance is ten years and the protection period lasts five years, the protection-period ratio is 50%. Appendix Table 2 shows that the protection-period ratio is uncorrelated with either contemporaneous firm characteristics or interest rate controls. The evidence is consistent with the protection period being set in a standard way to be about 50% of maturity at issuance, which alleviates concerns over the endogenous choice of the protection–period setting.

Moreover, in Appendix Table 3, I conduct a within-firm characteristic comparison conditional on $D(turn\_callable)$ switching from 0 to 1. All the observable firm characteristics are statistically indistinguishable when the instrumental variable $D(turn\_callable)$ switches. There are no significant firm observable changes when protection periods end and bonds turning effectively callable.

Lastly, I conduct the intention-to-treat (ITT) test for the IV regressions, assuming all the bonds in the speculative-grade sample have protection periods that last 50% of maturity at issuance. Appendix Table 4 present the results under the ITT assumption. The first-stage shows strong results for both indexes of early refinancing activities, while IV second-stage regressions show early refinancing leading to a larger fraction of book debt with maturity $\geq$5 years, as well as a longer average bond maturity. In terms of economics magnitudes, the results are similar to the IV regressions without ITT assumption.

Third, I conduct a second instrumental variable strategy exploring the fact that credit supply conditions greatly influence a firm's ability to refinance early. I instrument firms' early refinancing activities with the interaction between the callable fraction and credit supply conditions. Given that callable bonds make early refinancing easier, firms with more callable bonds receive a larger shock in their early refinancing ability when the credit market improves, and maturity extension.

Appendix Table 5 shows the regression results. In terms of economic magnitudes, the estimates show that a one–standard–deviation (30%) increase in the probability of early refinancing leads to a 21.2% increase in the fraction of book debt with maturity $\geq$5 years and a one-year extension of average bond maturity. The magnitude is qualitatively similar to the results from the first IV strategy.

In this paper, I am agnostic about what drives the variations in credit supply conditions. The drivers could be the countercyclical variation in the economy-wide prices of risk, or mispricing due to investor biases in evaluating credit risk, or investor sentiment. Instead of trying to disentangle or quantify those theories, I take the variation in aggregate credit supply conditions as given and study firms' reactions. As a robustness check, I use two other measures of credit supply conditions. The first is the excess bond premium (EBP) from Gilchrist and Zakrajšek [2012], which is a credit spread measure purged of default risk. An increase in the excess bond premium reflects a reduction in the effective risk-bearing capacity of the financial sector and, as a result, a contraction in credit supply. The second is the high-yield fraction, which is the fraction of new corporate issuance that is rated to be speculative. Greenwood and Hanson [2013] show that a decline in issuer quality is a reliable signal of credit market overheating. Both measures generate similar estimates in the tabulated results.

4 Precautionary Maturity Management: More Evidence

4.1 Heterogeneous Maturity Extension across Credit Rating Segments

Two factors subject speculative-grade firms to severe refinancing risk, leading them to conduct more precautionary maturity management than their investment-grade peers. First, changing credit supply conditions disproportionately affect the financing costs speculative-grade firms face. In Figure 3, I plot the Bank of America Merrill Lynch US corporate index for different ratings from 1997 to 2013. This plot highlights the large time-series variation of yields for speculative-grade firms. While yields for AAA, AA, and A ratings remain relatively stable throughout the period, the yields for speculative-grades are highly volatile. Take the C-rated firms as an example: the yield was lower than 15% during normal credit periods and increased to more than 25% around 2001 and 40% during the recent financial crisis.

Second, creditors prefer to keep speculative-grade firms on a short leash. This constraint leads to significant maturity mismatch between the assets and liabilities of speculative-grade firms, forcing them to frequently tap the capital markets for refinancing. To mitigate refinancing risk, speculative-grade firms synthesize long-term bonds via early refinancing when credit supply conditions are favorable.

There are various reasons that can lead to a credit supply constraint on maturity at which speculative-grade firms can issue at. For example, short-term debt provides creditors with additional flexibility to monitor managers frequently and aligns managerial incentives with that of the creditors (Calomiris and Kahn [1991], Diamond and Rajan [2001]). Short-term debt also enables the transfer of control rights (Hart and Moore [1994]), including the right to liquidate when entrenched managers have no incentive to pull the trigger. Additionally, credit rationing (Stiglitz and Weiss [1981]) leads to maturity rationing (Milbradt and Oehmke [2014]), where lending breaks down beyond a certain maturity because of asymmetric information and adverse selection.

The summary statistics reveal large-scale early refinancing and maturity extension only for speculative-grade firms, whereas investment-grade firms refinance early but do not extend maturity. To show the heterogeneity in the regression form, I interact the early refinancing activities with D(speculative), which equals 1 if firm i receives an S&P domestic long-term issuer credit rating below or equal to BB+. I run both OLS and IV regressions. In the IV regressions, I interact both the instrument and the instrumented variables with D(speculative). [8]

Table 4 presents heterogeneity results across the rating segments. Columns 1 and 2 display both the OLS and the IV results with outcome variable $F(Debt \geq 5Y)$, whereas column 3 and 4 display the results with average bond maturity as the outcome variable. IV results show that only

[8] See Appendix Section E for detailed specifications of the IV regressions.

speculative-grade firms extend maturity through early refinancing, but investment-grade firms do not. In columns 2 and 4, the coefficients for investment-grade firms remain insignificantly different from zero. In column 2, the coefficient for speculative-grade firms is 0.297 higher than that of investment-grade firms. In column 4, the coefficient for speculative-grade firms is 2.406 higher than that of investment-grade firms.

4.2 Maturity Mismatch between Assets and Liabilities

I also collect empirical evidence about speculative-grade firms being screened out of the long-term bond market, a scenario that leads to maturity mismatch in their assets and liabilities. In Figure 4, I plot the distribution of maturity at issuance for speculative-grade and investment-grade firms' bonds in the sample, with the summary statistics given at the top. The maturity at issuance of speculative-grade firms is highly clustered: the average maturity at issuance is 8.7 years, with a standard deviation of 2.3 years. In fact, about half of the bonds are issued with maturity around 10 years, and about 40% are issued with maturity around 7 years. Speculative-grade firms rarely issue bonds longer than 10 years, and the maximum maturity is 30 years. They only issue a few bonds shorter than 7 years. In contrast, the distribution for investment-grade firms is much more spread out: the average maturity at issuance is 11.1 years, with a standard deviation of 10.2 years. Investment-grade firms commonly issue bonds longer than 10 years, and the maximum maturity can reach 100 years.[9] They also often issue short-term bonds with maturity shorter than or equal to 5 years, accounting for almost 40% of the total issuance.

Not issuing long-term bonds does not prove the maturity mismatch between assets and liabilities. Speculative-grade firms might only invest in relatively short-term projects, which matches the maturity structure of their bonds. Documenting the maturity of investment projects is empirically challenging due to not having access to the underlying characteristics. To provide supportive evidence, I plot the distribution of maturity at issuance for speculative-grade and investment-grade

[9]For example, the Walt Disney Company issued senior debentures in 1993 that are due in 2093—the so-called "sleeping beauty" bond.

firms' bonds for the oil, gas, and coal industry and the telephone and television industry in Appendix Figure 1, with the summary statistics shown at the top. The idea is that firms in these two industries normally have long-term assets, and asset life across rating segments should not be significantly different. If there is still a difference in maturity at issuance for their bonds, the differences are more likely to come from the constraint in maturity at issuance, not the length of the underlying investment projects.

For these two industries, investment-grade firms' maturity at issuance becomes longer compared to the full sample investment-grade firms. The 25th percentile, median, and 75th percentile for the full sample investment-grade firms are 5, 9, and 12 years, respectively. For the oil, gas, and coal industry, the 25th percentile, median, and 75th percentile become 7, 10, and 20 years, respectively. For the telephone and television industry, they are 5, 10, and 30 years, respectively. Both of these industries issue larger fractions of bonds longer than 30 years. In contrast, speculative-grade firms in these industries still have a maturity-at-issuance distribution similar to the full sample of speculative-grade firms. The 25th percentile, median, and 75th percentile remain at 7, 9, and 10 years, respectively. They again rarely issue bonds longer than 10 years, and the maximum maturity is 20 years for the oil, gas, and coal industry, and 30 years for the telephone and television industry. This evidence favors the maturity mismatch between assets and liabilities in the speculative-grade segment.

Firms with larger maturity mismatch between assets and liabilities are more exposed to refinancing risk. We expect them to have a greater incentive to conduct precautionary maturity management. To test the heterogeneity across this dimension, I rank all eleven industries according to maturity mismatch between assets and liabilities. Given that the maturity of firms' asset side is not observable, I use the investment-grade firms as a benchmark, assuming they are relatively unconstrained in maturity at issuance and match the maturity of their assets and liabilities better. The maturity-mismatch measure is the difference in maturity at issuance between the investment-grade and speculative-grade bonds in an industry. Table 5 panel (a) presents the industry rankings, where a lower rank number indicates a larger maturity mismatch. Industries with the largest maturity mismatch are utilities; telephone and television; oil, gas, and coal; and healthcare, medical equipment, and drug. Those industries with the smallest mismatch are wholesale and retail; business equipment; manufacturing; and consumer durables. Rankings are aligned with the general consensus of the asset life for listed industries.

Table 5 panel (b) presents the IV regressions of early refinancing activities on two maturity measures. The IV regressions are run separately for industries with the smallest maturity-mismatch measure (rank 8–11) and largest maturity-mismatch measure (rank 1–4). Firms with smaller maturity mismatch (columns 1 and 3) are less exposed to refinancing risk and demonstrate a smaller response in maturity extension via early refinancing. For outcome variable $F(Debt \geq 5Y)$, the coefficient for smaller maturity-mismatch firms (rank 8–11) is 0.095 which is not statistically significant, whereas the coefficient for larger maturity-mismatch firms (rank 1–4) is 0.480, which is statistically significant at the 1% level. For the average bond maturity outcome variable, the coefficient for less mismatched firms is 0.058, which is not statistically significant, much smaller than the 3.592 for more mismatched firms (rank 1–4), which is statistically significant at the 5% level. The IV results support the concept that firms with larger maturity mismatch between assets and liabilities, that is, firms that are more exposed to refinancing risk, extend maturity more through early refinancing.

4.3 The Timing of Refinancing

If firms are worried about the possibility of not being able to refinance maturing debt, they would likely consider early refinancing. The precautionary maturity management hypothesis predicts that speculative-grade firms will deal with the maturing principal amount earlier than their investment-grade counterparts.

Figure 5 shows the ratio of time passed when refinanced, over maturity at issuance. The figure includes only bonds that are refinanced. The figure includes a total of 9,604 refinancing cases. If maturity at issuance is 10 years and the bond is refinanced at the end of the sixth year, the fraction of elapsed maturity at refinancing is 60%. I denote this as an instance of early refinancing. If a firm refinances a bond at the scheduled due date, the fraction of elapsed maturity at refinancing is one, and I denote this case as an instance of refinancing at maturity. I plot the distribution for both speculative-grade firms and investment-grade firms to explore the heterogeneity across these two credit segments. Maturity-at-issuance distributions for bonds refinanced before maturity and refinanced at maturity are shown at the top.

Figure 5 shows that the majority of speculative-grade firms' bonds are refinanced before the due date; less than 10% of refinancing cases occur at the due date. The largest chunk of refinancing happens after a bond reaches the middle of its maturity at issuance. In contrast, investment-grade firms refinance the majority of their bonds -over 70%- at maturity. I also compare the maturity at issuance for bonds refinanced at maturity with bonds refinanced before maturity. For speculative-grade firms, the maturity at issuance is similar across both groups. For investment-grade firms, bonds refinanced at maturity tend to be short-term bonds: their average length is 5.67 years. On the other hand, bonds refinanced before maturity tend to be long-term bonds: their average length is 16.79 years, which is significantly longer than the refinanced-at-maturity group.

The timing of refinancing across speculative-grade and investment-grade firms fits the different exposures to refinancing risk. Financing costs for investment-grade firms are relatively stable throughout good or bad credit supply conditions; hence firms can simply wait until the due date and then roll over. For speculative-grade firms, financing costs are volatile. Unable to foresee what would happen at the due date, speculative-grade firms are concerned about refinancing risks and prefer to refinance before the due date. In fact, Bank of America Merrill Lynch makes a recommendation to speculative-grade firms:"Don't wait too long to refinance upcoming maturities. Give yourself at least 18 months before your current financing matures, so that if any segment of the market shuts down for a few months, you'll still have time to get something done."[10] HSBC in May 2010 recommended the following:"Truly global investment-grade corporations have time to arrange their

[10]Bank of America Merrill Lynch: "The shifting sands of maturity walls-mirage or real risk?" http://corp.bankofamerica.com/documents/10157/67594/Shifting_Sands_of_Maturity_Walls.pdf

refinancing. [Less highly rated companies] should be taking action now, while yields are low and margins compressed."[11]

There might be concerns that speculative-grade firms conduct more early refinancing for interest rate savings — firms call back the outstanding bonds when the call options are in the money. In order to exclude early refinancing potentially driven by interest rate reductions, I also test non-callable bonds. For non-callable bonds, firms can only refinance early through tender offers, repurchases and make–whole calls, which does not save interest payments. Firms need to pay at least the market prices in repurchases, and typically plus some premium in tender offers. A make–whole call is essentially prepayment with penalty, because all the future coupons have to be paid at a discount rate close to the Treasury rate. An untabulated figure for non-callable bonds delivers a similar message as the full bond sample, if not stronger. Investment-grade firms always refinance right at the due date, while speculative-grade firms tend to refinance long before the due date.

4.4 Which Bonds do Firms Refinance Early?

If maturity extension is a major goal that speculative-grade firms desire to achieve, maturity should be a good predictor of the bonds that firms target for early refinancing. Does shorter maturity make a bond more likely to be refinanced early than others bonds? Does firm credit worthiness matter in this setting?

To answer these questions, I run the following regression for speculative-grade firms and investment-grade firms separately. For bond i for firm j in year t, when firm j conducts early refinancing,

$$D(Early\_refinanced)_{i,j,t} = \alpha + \beta * Maturity_{i,j,t} + \theta * yield_{i,j,t} + \phi_i * Controls_{i,j,t} + \eta_{j,t} + \varepsilon_{i,j,t} \quad (1)$$

Dependent variable D(Early-refinanced) equals one if firm j refinances bond i early in year t, and zero if bond i stays untouched. The coefficient on maturity β and the coefficient on yield θ are the focus here. Given that I include the firm-year fixed effect, the comparison is made among all

[11] Global Finance Magazine, May 2010 cover story: Hitting a Wall of Debt.

the bonds outstanding for a given firm-year. The bond characteristics on the right-hand side of the regressions include: a dummy variable indicating whether or not bond i is callable at year t, previous year-end amount outstanding,[12] maturity at issuance, covenant count, seniority level,[13] and bond rating at the beginning of year t.

Equation 1 is estimated using a linear probability model. Table 6 presents the results for speculative-grade and investment-grade firms. Speculative-grade firms target bonds maturing sooner and do not tie early refinancing to the yield. In contrast, investment-grade firms target bonds with a higher yield when refinancing early, but do not specifically consider maturity.

For speculative-grade firms, a one-year decrease in maturity increases the probability of being refinanced early by 0.028. Thus, if one bond is five years shorter in maturity than the average maturity of bonds outstanding, this bond is 15% more likely to be refinanced early compared to other outstanding bonds. For these firms, the coefficient on yield is not significantly different from 0. On the other hand, investment-grade firms do not appear to consider maturity when they refinance early–the coefficient for maturity is zero. Instead, they target more expensive bonds: a 1% increase in yield-to-maturity leads to a 1.4% higher probability of the bond being refinanced early. Thus, if a bond has a yield that is 5% higher than the average yield of bonds outstanding, it is 7% more likely to be refinanced early compared to other outstanding bonds.

5 Discussion

Other forms of internal liquidity, such as credit lines and cash, can also help mitigate refinancing risk. Can the behavior in precautionary maturity management across credit ratings be explained by cash holdings and credit–lines access? In other words, do investment-grade firms not conduct precautionary maturity management because they have more credit–line access and cash as backups? To examine this possibility, I tabulate the summary statistics for credit–line access and cash for the

[12] I use the previous year-end amount outstanding to represent size as the amount outstanding can be different from the issuing principle amount due to previous retirement activities.

[13] Seniority level is coded into numeric value, with larger values representing higher seniority levels.

sample firms.

The results in Table 7 panel (a) show that investment-grade firms hold a significantly lower amount of cash, and are less likely to have credit lines or have used their credit lines. I use two indicators to denote firms' access to credit lines. One is D (Credit line), a dummy variable that equals 1 if firm i has access to credit lines in year t. The second is D(Credit line-drew), a dummy variable that equals one if firm i drew on its credit lines in year t. I also use two ratios to measure firms' cash situation. The first is Cash/Assets, which measures the total cash reserves, and the second one is Cash Flow/Assets, which measures the annual cash flow. More specifically, investment-grade firms are 25.6% less likely to have a credit line and 8% less likely to have drawn on their credit lines. The cash reserves of investment-grade firms are 0.6% lower than speculative-grade firms, which is not a large difference in terms of economic magnitude. However, investment-grade firms generate significantly higher cash flows: their average Cash Flow/Assets ratio is 11.5%, almost double the 5.9% of their speculative-grade counterparts. The high level of incoming cash flow attenuates the need for credit–line access and cash holdings.

Existing literature has shown that credit lines and holding cash pose challenges for speculative-grade firms in liquidity hedging. According to Sufi [2009a], lines of credit are a viable liquidity substitute only for firms that maintain a high cash flow. When the credit supply tightens markedly, such as during the recent financial crisis, financially-constrained firms face the risk of having their credit lines pulled (Ivashina and Scharfstein [2010], Campello et al. [2010]). Also, the terms of financially-constrained firms' credit lines worsened: credit line maturity declined and the interest rate charged on funds drawn increased (Campello et al. [2011]). Meanwhile, holding excess cash reserves can help to reduce refinancing risk but can be an expensive alternative (Holmström and Tirole [2000]). The agency costs of free cash flow would be another main concern for large cash holdings by these kind of firms (Jensen [1986], Harford [1999], Dittmar and Mahrt-Smith [2007], Harford et al. [2008]). As discussed above, speculative-grade firms do not appear to hold large amounts of cash.

On the other hand, Harford et al. [2014] suggest that cash holdings help firms avoid refinancing risk, and Lins et al. [2010] suggest that non-operational cash hedges against future cash flow shocks in bad times. To study the interaction between internal liquidity and precautionary maturity management through corporate bonds, I separate speculative-grade firms into two groups according to their credit–line access and cash situation.

Table 7 panels (b) and (c) present the OLS and IV results with $D(Early\_refi)$ interacting with both indicators of firms' access to credit lines. Across the regressions, credit–line access does not affect firms' early refinancing and maturity extension within the speculative-grade segment. The coefficients for D(Speculative), which is the baseline regression, show strong precautionary maturity extension through early refinancing. But the coefficients of the credit–line-access indicators remain insignificantly different from zero across the regressions. Whether or not a firm has credit lines, or credit lines that have been accessed, does not affect their precautionary maturity extension through early refinancing. The results confirm those of previous studies, where credit lines are not a viable liquidity source for financially-constrained firms, especially when credit supply tightens.

Table 8 panels (a) and (b) present the OLS and IV results with $D(Early\_refi)$ interacting with both indicators of firms' cash situations. Across the regressions, there is no evidence that cash holdings affect speculative-grade firms' decisions to extend maturities through early refinancing. The coefficients for D(Speculative), which is the baseline regression, again shows strong precautionary maturity extension through early refinancing. However, the coefficients of the cash-situation measures remain insignificantly different from zero. Cash holding variations within speculative-grade do not affect how much precautionary maturity management that firms conduct through early refinancing of corporate bonds.

6 Conclusion

This paper illustrates how speculative-grade firms actively manage their debt maturity via early refinancing of corporate bonds, in which they retire outstanding bonds long before the due date and issue new bonds with longer maturity as replacements. In particular, they refinance early on a large scale when credit supply conditions are good, leading to a pro-cyclical maturity structure. Evidence is consistent with speculative-grade firms precautionarily managing their maturity to hedge against credit supply fluctuations. The idea is that by "kicking maturity down the road," speculative-grade firms reduce the possibility of being forced to refinance during future credit market downturns. Investment-grade firms, however, do not manage their maturity in the same way, as they are less exposed to refinancing risk caused by credit supply fluctuations.

This paper presents a new perspective on the early refinancing of corporate bonds – early refinancing serves to adjust firms' maturity structure in addition to reducing interest payments. It also sheds light on the relation between debt maturity structure and refinancing risk, the heterogeneous maturity management across credit segments, and the impact of ex-post refinancing on the ex-ante choice of maturity at issuance. It emphasizes how credit supply conditions influence observed financial structure and corporate behavior, and presents maturity as an important channel.

While shedding light on a number of issues, this paper also raises additional questions. For example, the literature attributes early refinancing to interest rate movements. My paper suggests a new perspective of early refinancing: it is a state-contingent maturity extension device. Whether or not, and how do firms trade-off interest rate reduction with maturity extension in their early refinancing decisions? I look forward to future research that addresses these and other related questions.

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Table 1: Summary Statistics

This table presents summary statistics for 31,640 bonds from 1,497 nonfinancial US firms for the period 1996–2011. Panel (a) presents means, standard deviations, and median of firms' characteristics. The unit of observation is at the firm-year level, and the summary statistics are calculated by pooling all the firm-year observations. All variables are defined in Appendix Section B. Panel (b) presents the distribution of sample firms across 12 industries as classified by Fama and French, and compares it with the distribution of the overall Compustat universe. Panel (c) presents summary statistics of bond characteristics at issuance. All bond characteristics are defined in Appendix Section C.

(a) Firm Characteristics Summary

	Sample Firms			Compustat Firms		
Variable	**Mean**	**SD**	**Median**	**Mean**	**SD**	**Median**
Assets ($Millions)	11,376.12	34,472.62	2,930.33	2,715.75	15,363.85	117.20
Book Leverage	0.41	0.22	0.37	0.25	0.27	0.18
Market/Book	1.57	0.92	1.32	3.85	9.49	1.53
EBITDA/Assets	0.13	0.1	0.12	-0.21	1.08	0.08
Cash/Assets	0.07	0.09	0.04	0.21	0.25	0.10
Tangible/Assets	0.39	0.25	0.35	0.29	0.27	0.20
KZ Index	-2.2	21.28	0.57	-6.19	15.68	-0.40
S&P Credit Rating	0.90	0.30	1.00	0.18	0.38	0.00
Equity Return	0.14	0.73	0.05	0.17	0.97	-0.02
Firm-Year Obs	15,196	15,196	15,196	133,539	133,539	133,539
Firms	1,497	1,497	1,497	17,201	17,201	17,201

(b) Distribution of Firms across Industries

	Data Sample		Compustat Sample	
Industry	N	Percentage	N	Percentage
Consumer Nondurables	128	8.55	712	5.79
Consumer Durables	52	3.47	344	2.80
Manufacturing	253	16.9	1,268	10.31
Oil, Gas, & Coal	144	9.62	635	5.17
Chemicals & Allied Products	73	4.88	299	2.43
Business Equipment	102	6.81	2,993	24.35
Telephone & Television	133	8.88	534	4.34
Utilities	101	6.75	229	1.86
Wholesale, Retail, & Some Services	179	11.96	1,407	11.45
Healthcare, Medical Equip., & Drugs	80	5.34	1,617	13.15
Everything Else	252	16.83	2,255	18.34
Total	1,497	100	12,293	100

(c) Bond Characteristics at Issuance

Variable	**N**	**Mean**	**STD**	**P10**	**P50**	**P90**
Offering Amount ($Mils)	31,640	223.87	352.01	2.52	100.00	530.00
Maturity at Issuance	31,621	10.28	9.08	2.92	8.33	25.08
Coupon	31,625	6.60	2.59	3.38	6.65	9.75
Speculative Grade (D)	30,043	0.30	0.46	0.00	0.00	1.00
Covenant (D)	18,435	0.99	0.11	1.00	1.00	1.00
Covenant Count	18,402	4.15	2.37	1.00	4.00	8.00

Table 2: Early Refinancing Activities and Outcomes

Panel (a) presents the aggregate dollar amount of early refinancing, maturing, and total amount outstanding across all sample firms. I define refinancing to have occurred if within a three-month time window centered on the month a bond is retired, firms issue other bonds with a dollar amount comparable to the retired amount. Early refinancing refers to the cases in which refinancing happens at least six months before the scheduled due date of the bond.
Panel (b) presents a comparison of bond characteristics between the retired bonds and the new bonds when firms refinance early. The unit of observation is at firm-year level by averaging observations within that firm-year. Two sample t-tests are presented. The results are presented for speculative-grade and investment-grade separately.
*** significant at 1% level. ** significant at 5% level. * significant at 10% level.

(a) Early Refinancing Activities

Year	**Early Refinancing**	**Maturing**	**Total**
1996	9.27	23.25	577.06
1997	17.43	34.36	688.31
1998	25.90	33.17	854.12
1999	13.22	37.35	1,039.08
2000	9.59	54.74	1,151.31
2001	27.61	75.66	1,352.60
2002	25.53	83.66	1,493.77
2003	56.42	119.46	1,580.63
2004	53.82	106.27	1,595.69
2005	36.26	115.21	1,598.49
2006	43.41	125.65	1,661.84
2007	42.07	126.16	1,737.11
2008	23.02	110.79	1,879.86
2009	43.27	139.67	2,094.38
2010	78.04	118.05	2,217.01
2011	55.76	142.03	2,320.87

(b) Comparison of Bond Characteristics at Early Refinancing

	Speculative-Grade			Investment-Grade		
	Retired	New	New-Retired	Retired	New	New-Retired
Maturity	3.91	8.79	4.88 ***	11.49	12.47	0.98
Maturity at Issuance	8.58	8.80	0.22**	18.55	13.09	-5.46***
Coupon	9.47	8.28	-1.18***	7.13	5.24	-1.89***
Covenant Count	6.97	6.03	-0.93***	3.45	3.26	-0.18*
Covenant (D)	1	1	0	1	0.98	0.01

Table 3: IV Strategy Results

This table presents IV results, where $D(Early\_refi)_{i,t}$ is instrumented by $D(turn\_callable)_{i,t}$, a dummy variable indicating that some bonds are scheduled to become callable in year t for firm i. Two measures of maturity are used: F(Debt$\geq 5Y$) is the fraction of book debt with maturity of five years or longer, and Bond Maturity is the average bond maturity. Observations are at the firm-year level. Firm characteristic controls include Ln(Assets), book leverage, EBITDA/Assets, Cash/Assets, Tangible/Assets, Market/Book, equity return, and S&P long-term rating. Interest rate controls include 3-month T-bill rate, term spread (10-year corporate yield minus 1-year corporate yield), and BAA-AAA. Sample firms are restricted in the speculative-grade firms. Standard errors are clustered by industry-year.
*** significant at 1% level. ** significant at 5% level. * significant at 10% level.

$$Maturity_{i,t} = \delta_0 + \delta_1 D(\widehat{Early\_refi})_{i,t} + \sum_j \delta_j controls_{j,i,t} + \varepsilon_{it} \qquad 2nd \;\; stage$$

$$D(Early\_refi)_{i,t} = \beta_0 + \beta_1 D(turn\_callable)_{i,t} + \sum_j \beta_j controls_{j,i,t} + e_{i,t} \quad 1st \;\; stage$$

(a) IV Strategy First Stage

	(1) D(Early_refi)	(2) F(Early_refi)
D(turn_callable)	0.096***	0.029***
	(0.015)	(0.009)
Firm FE	Y	Y
Year FE	Y	Y
Controls	Y	Y
Sample	Speculative	Speculative
R-squared	0.097	0.058
N	4134	3822

(b) IV Strategy Second Stage

	F(Debt≥5Y)		Bond Maturity	
	(1)	(2)	(3)	(4)
	OLS	IV	OLS	IV
D(Early_refi)	0.102***	0.368**	1.137***	3.971***
	(0.013)	(0.149)	(0.079)	(1.111)
F-stat (1st stage)		35.06		36.38
Firm FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Firm Controls	Y	Y	Y	Y
Interest Rate Controls	Y	Y	Y	Y
Sample	Speculative	Speculative	Speculative	Speculative
R-squared	0.146	-0.131	0.362	-0.484
N	3604	3604	4221	4221

Table 4: Heterogeneous Maturity Extension across Credit Ratings

This table presents the OLS and IV results where $D(Early\_refi)_{i,t}$ is interacted with $D(speculative)$. In IV regressions I interact both the instrumental and instrumented variables with D(speculative).

Two measures of maturity are used: F(Debt$\geq 5Y$) is the fraction of book debt with maturity of five years or longer, and Bond Maturity is the average bond maturity. Observations are at the firm-year level. Firm characteristic controls include Ln(Assets), book leverage, EBITDA/Assets, Cash/Assets, Tangible/Assets, Market/Book, equity return, S&P long-term rating, and the callable fraction. Interest rate controls include 3-month T-bill rate, term spread (10-year corporate yield minus 1-year corporate yield), and BAA-AAA. Standard errors are clustered by industry-year.

*** significant at 1% level. ** significant at 5% level. * significant at 10% level.

$$Maturity_{i,t} = \delta_0 + \delta_1 D(Early\_refi)_{i,t} + \delta_2 * D(spec)_{i,t} + \delta_3 D(Early\_refi)_{i,t} * D(spec)_{i,t} + \sum_j \delta_j controls_{j,i,t} + \varepsilon_{it}$$

	F(Debt≥5Y)		Bond Maturity	
	(1)	(2)	(3)	(4)
	OLS	IV	OLS	IV
D(Early_refi)	0.052***	0.210	0.264***	-0.061
	(0.010)	(0.150)	(0.082)	(0.711)
D(Early_refi)*D(Speculative)	0.100***	0.297*	1.146***	2.406***
	(0.020)	(0.160)	(0.116)	(0.853)
Firm FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Controls	Y	Y	Y	Y
Sample	All	All	All	All
R-squared	0.121	-0.153	0.106	0.047
N	7276	7276	8455	8455

Table 5: Maturity Mismatch Analysis

In this table, panel (a) shows the ranks of the industries based on the difference of maturity at issuance between speculative-grade and investment-grade bonds. A lower rank number indicates larger difference. For each industry, two sample t-tests are conducted.

Panel (b) presents the IV results of early refinancing on maturity for firms grouped by maturity mismatch measure. Industries with mismatch rank 1–4 are grouped to represent a large maturity mismatch, and the other four industries with rank 8–11 are grouped to represent a small maturity mismatch. Two measures of maturity are used: F(Debt$\geq 5Y$) is the fraction of book debt with maturity of five years or longer, and Bond Maturity is the average bond maturity. Observations are at the firm-year level. Firm characteristic controls include Ln(Assets), book leverage, EBITDA/Assets, Cash/Assets, Tangible/Assets, Market/Book, equity return, S&P long-term rating, and the callable fraction. Interest rate controls include 3-month T-bill rate, term spread (10-year corporate yield minus 1-year corporate yield), and BAA-AAA. Sample firms are restricted in the speculative-grade firms. Standard errors are clustered by industry-year.

*** significant at 1% level. ** significant at 5% level. * significant at 10% level.

(a) Maturity Mismatch Rank

	Mismatch Rank	Speculative	Investment	Investment-Speculative
Telephone & Television	1	8.80	16.23	7.44***
Utilities	2	8.92	16.16	7.24***
Oil, Gas, & Coal	3	8.59	14.58	5.99***
Healthcare, Medical Equip., & Drugs	4	8.49	13.72	5.23***
Consumer Nondurables	5	8.99	12.69	3.70***
Chemicals & Allied Products	6	8.35	10.82	2.47***
Everything Else	7	8.74	10.93	2.19***
Wholesale, Retail, & Some Services	8	8.54	9.96	1.42***
Business Equipment	9	8.26	8.75	0.49
Manufacturing	10	8.92	8.61	-0.31
Consumer Durables	11	8.75	6.15	-2.60***

(b)

	F(Debt≥5Y)		Bond Maturity	
	(1)	(2)	(3)	(4)
	Rank 8–11	Rank 1–4	Rank 8–11	Rank 1–4
	IV	IV	IV	IV
D(Early_refi)	-0.052	0.480***	0.492	3.630**
	(0.288)	(0.184)	(0.847)	(1.676)
F-stat (1st stage)	11.64	15.91	9.47	18.79
Firm FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Controls	Y	Y	Y	Y
Sample	Speculative	Speculative	Speculative	Speculative
R-squared	0.031	-0.160	0.209	0.310
N	1126	1032	1322	1321

Table 6: Bond Characteristics and Early Refinancing

What kind of bonds are more likely to be early refinanced? This table presents the results from a linear regression of being early refinanced on various bond characteristics. The unit of observation is at the bond-firm-year level. firm-year fixed effect is applied for each regression. Regressions are run separately for speculative-grade and investment-grade firms. Only firm-year observations with early refinancing activities are included in the regression. The dependent variable $D(Early\_refi)_{i,j,t}$ equals one if firm j early refinanced an outstanding bond i in year t, and zero if bond i stayed untouched. Bond characteristics, such as maturity, yield-to-maturity, a flag indicating a bond is callable in this year, previous year end amount, maturity at issuance, covenant count, security level, and bond rating, are included in the regression. Standard errors are clustered by firm.
*** significant at 1% level. ** significant at 5% level. * significant at 10% level.

$$D(Early\_refinanced)_{i,j,t} = \alpha + \beta * Maturity_{i,j,t} + \theta * Yield_{i,j,t} + \sum_k \phi_{i,k} * Controls_{i,j,k,t} + \theta_{i,t} + \varepsilon_{i,j,t}$$

	Dependent Variable: $D(Early\_refinanced)_{ijt}$	
	Speculative-Grade	Investment-Grade
Maturity	-0.028***	0.000
	(0.008)	(0.001)
Yield	-0.003	0.014***
	(0.006)	(0.002)
D(Callable)	0.556***	0.348***
	(0.046)	(0.088)
Previous Year-End Amount ($Mils)	0.152***	0.021***
	(0.049)	(0.005)
Maturity at Issuance	0.018***	-0.001
	(0.005)	(0.001)
Covenant Count	0.009	0.006**
	(0.012)	(0.002)
Seniority Level	-0.001	0.001
	(0.033)	(0.009)
Bond Rating	-0.003	-0.004
	(0.012)	(0.003)
Constant	0.072	-0.052
	(0.288)	(0.060)
Fixed Effect	Firm–Year	Firm–Year
R-squared	0.516	0.415
N	1834	13483

Table 7: Credit Lines and Precautionary Maturity Management

Panel (a) presents firm internal liquidity summary by separating speculative-grade firm and investment-grade firms. Two sample t-tests are conducted .

Panels (b) and (c) restrict the sample to speculative-grade firms and presents the OLS and IV results where $D(Early\_refi)_{i,t}$ is interacted with $D(creditline)$, and $D(creditline\_drew)$. D(creditline) equals one if firm i has access to credit lines in year t. $D(creditline\_drew)$ equals one if firm i used part of its credit lines in year t.

Two measures of maturity are used: F(Debt$\geq 5Y$) is the fraction of book debt with maturity≥5 years, and Bond Maturity is the average bond maturity. Observations are at the firm-year level. Firm characteristic controls include Ln(Assets), book leverage, EBITDA/Assets, Cash/Assets, Tangible/Assets, Market/Book, equity return, S&P long-term rating, and the callable fraction. Interest rate controls include 3-month T-bill rate, term spread (10-year corporate yield minus 1-year corporate yield), and BAA-AAA. Sample are restricted in the speculative-grade firms. Standard errors are clustered by industry-year.

*** significant at 1% level. ** significant at 5% level. * significant at 10% level.

$$Maturity_{i,t} = \delta_0 + \delta_1 D(Early-refi)_{i,t} + \delta_2 D(Early\_refi)_{i,t} * D(creditline)_{i,t} + \sum_j \delta_j controls_{j,i,t} + \varepsilon_{it}$$

$$Maturity_{i,t} = \delta_0 + \delta_1 D(Early-refi)_{i,t} + \delta_2 D(Early-refi)_{i,t} * D(creditline\_drew)_{i,t} + \sum_j \delta_j controls_{j,i,t} + \varepsilon_{it}$$

(a)

Variable	Speculative	Investment	Speculative-Investment	P-value
D(Creditline)	0.783	0.527	0.256***	0
D(Creditline_drew)	0.718	0.638	0.080***	0
Cash/Assets	0.073	0.067	0.006***	0
Cash Flow/Assets	0.059	0.115	-0.057 ***	0

(b)

	F(Debt≥5Y)		Bond Maturity	
	OLS	IV	OLS	IV
D(Early_refi)	0.107**	0.476	1.079***	3.118**
	(0.045)	(0.792)	(0.142)	(1.525)
D(Early_refi)*D(creditline)	0.063	0.085	0.383**	-1.073
	(0.048)	(0.770)	(0.164)	(1.370)
Firm FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Controls	Y	Y	Y	Y
Sample	Speculative	Speculative	Speculative	Speculative
R-squared	0.087	-0.183	0.276	0.143
N	1940	1940	2317	2317

(c)

	F(Debt≥5Y)		Bond Maturity	
	OLS	IV	OLS	IV
D(Early_refi)	0.208***	0.569**	1.562***	2.605***
	(0.038)	(0.263)	(0.175)	(0.776)
D(Early_refi)*D(creditline_draw)	-0.059	-0.347	-0.182	-0.568
	(0.040)	(0.242)	(0.203)	(0.677)
Firm FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Controls	Y	Y	Y	Y
Sample	Speculative	Speculative	Speculative	Speculative
R-squared	0.099	0.004	0.285	0.216
N	1558	1558	1854	1854

Table 8: Cash and Precautionary Maturity Management

Panels (a) and (b) restrict the sample to speculative-grade firms and presents the OLS and IV results where $D(Early\_refi)_{i,t}$ is interacted with $D(low\_cash)$, and $D(low\_cashflow)$. $D(low\_cash)$ equals one if firm i's cash holdings are lower than the median cash holdings among all speculative-grade firms in year t-1. $D(low\_cashflow)$ equals one if firm i's Cash Flow/Assets is lower than the median Cash Flow/Assets among all speculative-grade firms in year t-1.
Two measures of maturity are used: F(Debt$\geq 5Y$) is the fraction of book debt with maturity $\geq$5 years, and Bond Maturity is the average bond maturity. Observations are at the firm-year level. Firm characteristic controls include Ln(Assets), book leverage, EBITDA/Assets, Cash/Assets, Tangible/Assets, Market/Book, equity return, S&P long-term rating, and the callable fraction. Interest rate controls include 3-month T-bill rate, term spread (10-year corporate yield minus 1-year corporate yield), and BAA-AAA. Sample firms are restricted in the speculative-grade firms. Standard errors are clustered by industry-year.
*** significant at 1% level. ** significant at 5% level. * significant at 10% level.

$$Maturity_{i,t} = \delta_0 + \delta_1 D(Early\_refi)_{i,t} + \delta_2 D(Early\_refi)_{i,t} * D(low\_cash)_{i,t} + \sum_j \delta_j controls_{j,i,t} + \varepsilon_{it}$$

$$Maturity_{i,t} = \delta_0 + \delta_1 D(Early\_refi)_{i,t} + \delta_2 D(Early\_refi)_{i,t} * D(low\_cash\,flow)_{i,t} + \sum_j \delta_j controls_{j,i,t} + \varepsilon_{it}$$

(a)

	F(Debt≥5Y)		Bond Maturity	
	OLS	IV	OLS	IV
D(Early_refi)	0.154***	0.534**	1.434***	2.457***
	(0.024)	(0.236)	(0.104)	(0.627)
D(Early_refi)*D(low_cash)	-0.007	0.179	-0.042	0.053
	(0.029)	(0.190)	(0.140)	(0.451)
Firm FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Controls	Y	Y	Y	Y
Sample	Speculative	Speculative	Speculative	Speculative
R-squared	0.076	-0.363	0.277	0.150
N	2682	2682	3249	3249

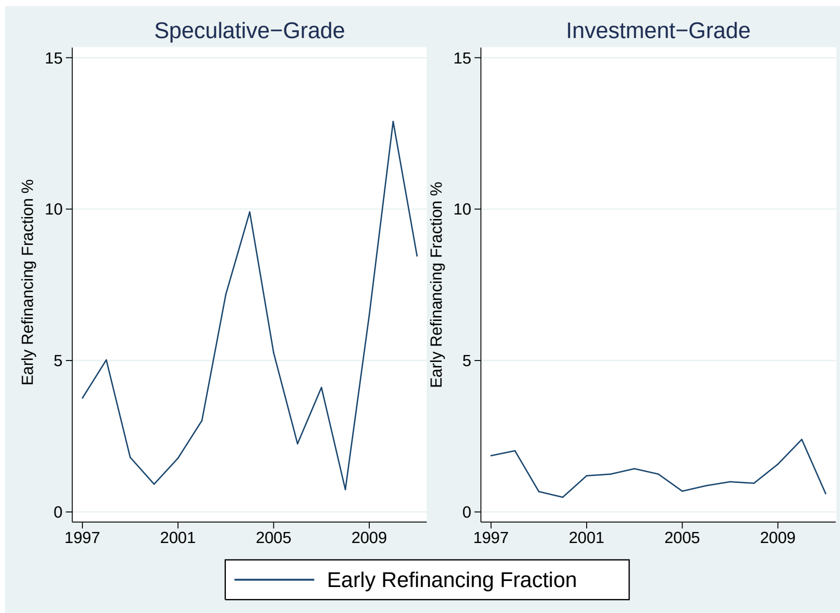
(b)

	F(Debt≥5Y)		Bond Maturity	
	OLS	IV	OLS	IV
D(Early_refi)	0.157***	0.637***	1.551***	2.373***
	(0.022)	(0.221)	(0.107)	(0.536)
D(Early_refi)*D(low_cash flow)	-0.014	-0.099	-0.256*	0.421
	(0.027)	(0.187)	(0.133)	(0.454)
Firm FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Controls	Y	Y	Y	Y
Sample	Speculative	Speculative	Speculative	Speculative
R-squared	0.077	-0.279	0.284	0.126
N	2632	2632	3184	3184

Figure 1: Early Refinancing and Changes in Maturity

Panel (a) shows the average early refinancing fraction for speculative-grade and investment-grade firms. For each firm-year, the fraction is the ratio of the early refinancing dollar amount to the total dollar amount of outstanding bonds at previous year-end. Panel (b) shows the correlation between firms' early refinancing fraction (left scale) and change in average bond maturity (right scale). Change in average bond maturity is calculated as the change in the average maturity of outstanding bonds divided by the previous year-end average maturity. All series are calculated by taking the average across sample firms in a given year.

(a) Early Refinancing Activities across Credit Ratings



(b) Early Refinancing and Maturity Extension across Credit Ratings

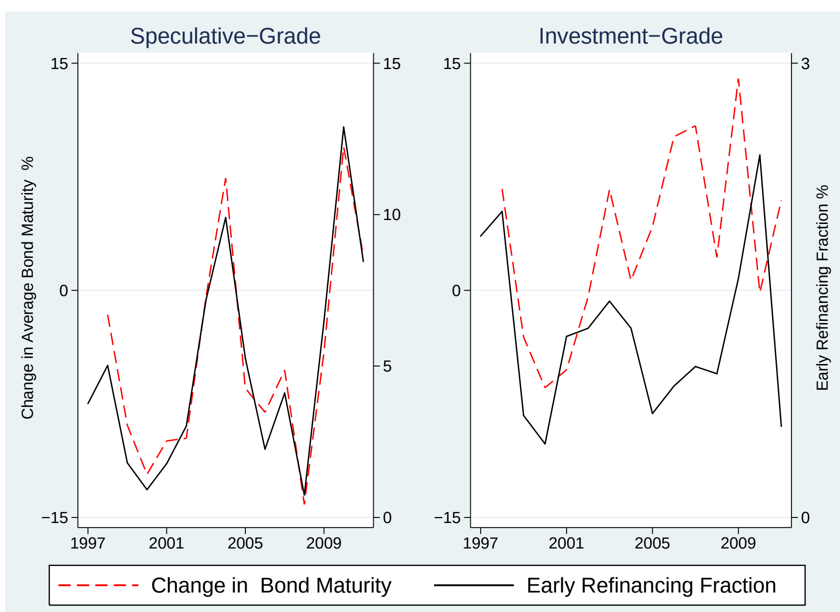


Figure 2: Early Refinancing Decomposition

This figure shows the aggregate amount of different methods of early refinancing for sample firms for the period 1997–2011.

Calls: actions taken to pay the principal amount prior to the stated maturity date, in accordance with the call provisions stated in the proceedings.

Repurchases: issuer purchases the issue in the open market.

Tender Offers: bond holders are invited to tender their bonds for cash.

Make Whole Calls: issuers may call these bonds at par plus a premium. This premium is derived from discounting all the future coupon payments by the yield of a comparable Treasury security plus additional basis points.

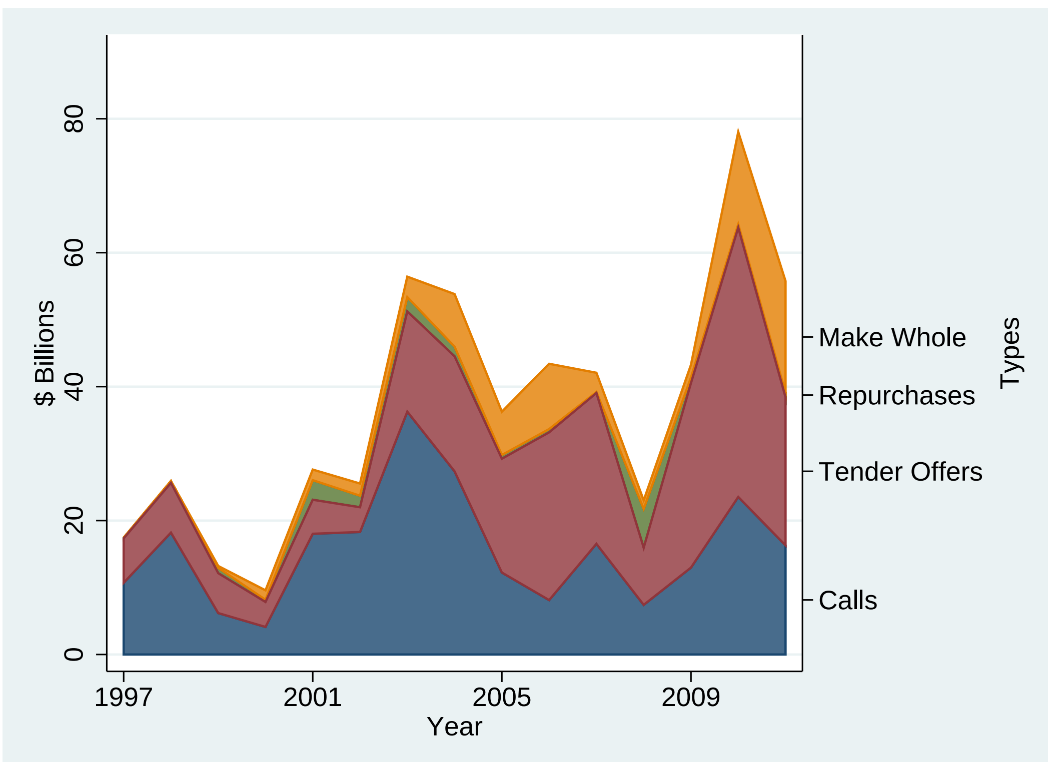


Figure 3: Bank of America Bond Yields for Different Rating Groups

This figure presents the monthly effective yields of the Bank of America Merrill Lynch US Corporate index for the AAA, AA, A, BBB, BB, B, and C rating groups for the period 1997 to 2013. This index tracks the performance of US dollar denominated corporate debt publicly issued in the US domestic market. The data sequence is obtained from the FRED database from the Federal Reserve Bank of St. Louis.

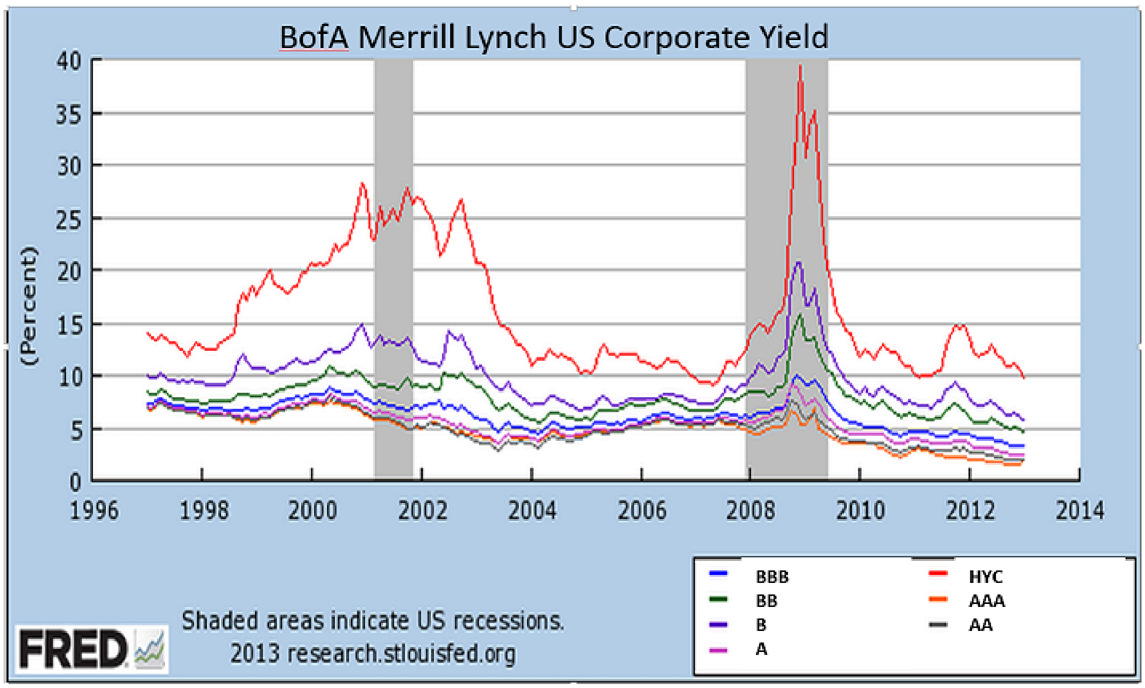


Figure 4: Maturity at Issuance

The distribution of maturity at issuance is reported for speculative-grade and investment-grade firms' bonds, along with a histogram of the distribution. For investment-grade firms, bonds with maturity at issuance longer than 30 years are included in the 30-year category in the histogram.

Unit(Year)	Mean	Std	P25	P50	P75	Max
Speculative-grade	8.7	2.3	7	9	10	30
Investment-grade	11.1	10.2	5	9	12	100

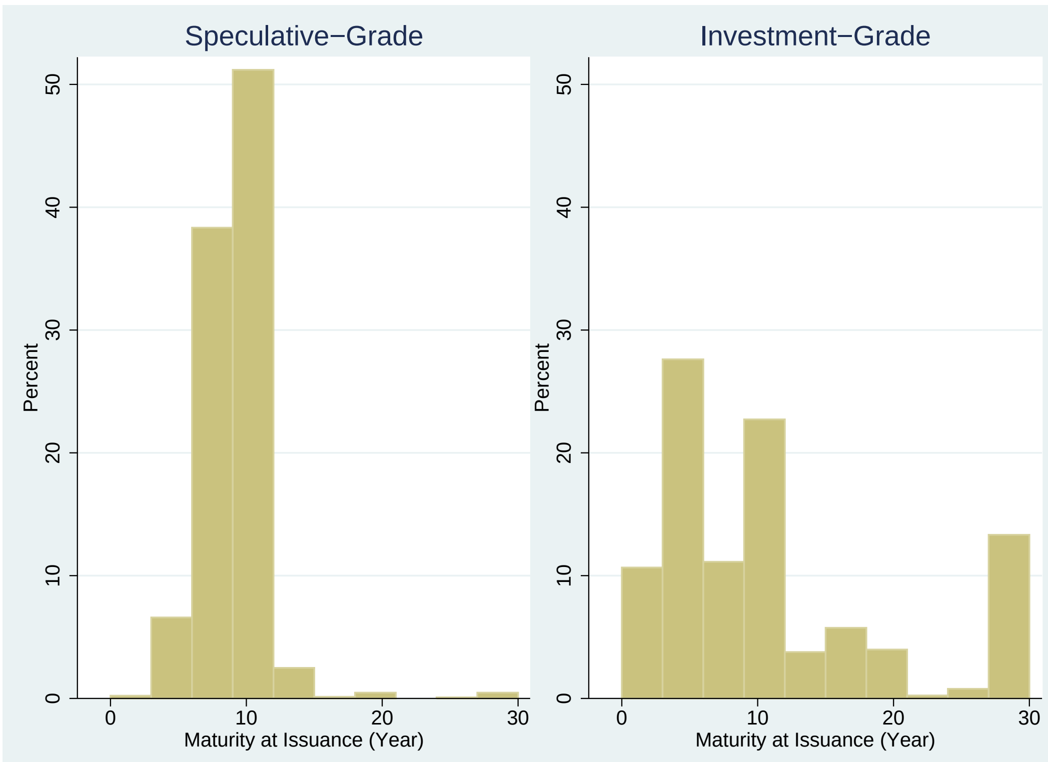
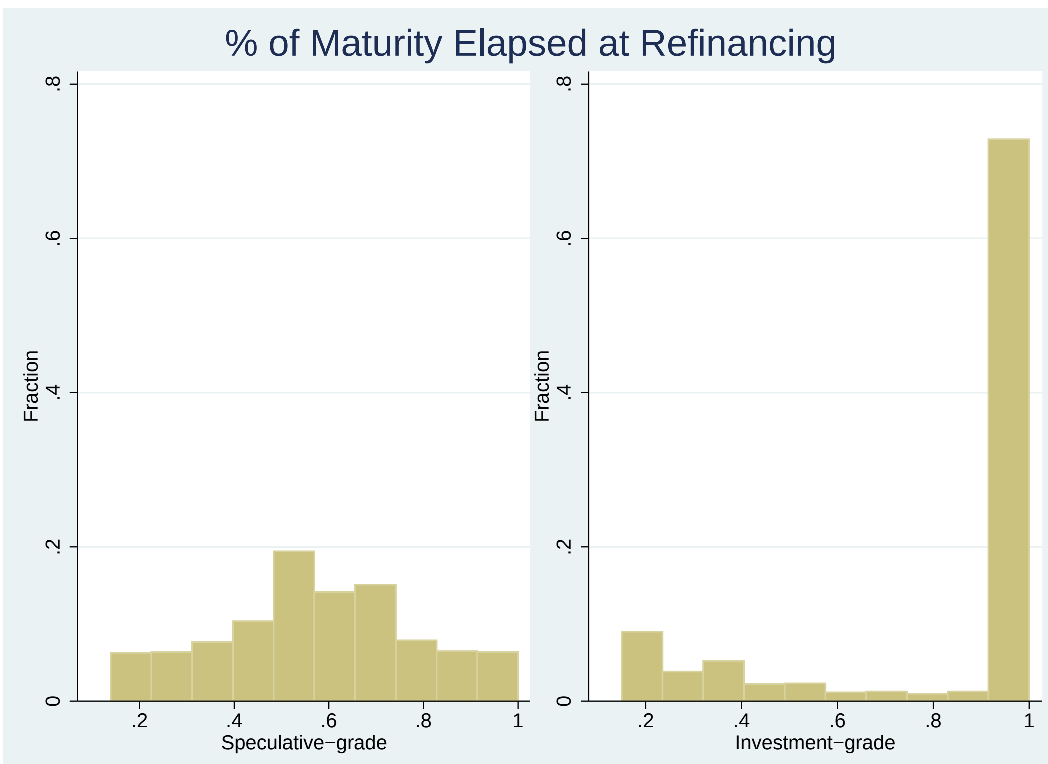


Figure 5: Maturity Elapsed at Refinancing

This figure shows the distribution of % of maturity elapsed at refinancing for both speculative-grade firms and investment-grade firms' bonds. The sample is restricted to bonds being refinanced and excludes bonds that are retired but not refinanced. If maturity at issuance is 10 years and the bond is refinanced at the end of the 6th year after issuance, then the elapsed maturity at refinancing is 60%. If the bond is refinanced at scheduled maturity, then elapsed maturity at refinancing is 100%.

Unit(Year)	Mean(At Maturity)	Mean(Before Maturity)	At-Before	P-value
Speculative-grade	8.22	8.55	-0.34	0.46
Investment-grade	5.67	16.79	-11.12	0.00



Appendix

A Action Types

- Calls: actions taken to pay the principal amount prior to scheduled maturity date, in accordance with the embedded call provision of the security.
- Make-Whole Calls: issuers buy back bonds at par plus a premium. This premium is derived by discounting all the future interest payment by the yield of a comparable Treasury security plus additional basis points.
- Repurchases: issuers purchase the bond in the open market.
- Tender offers: bond holders are invited to tender their bonds for cash.

B Variable Definitions

Total Assets=at

Book Leverage=(dlc+dltt) / at

EBITDA / Assets=ebitda/ at

Cash Flow/Assets=(ib+dpc)/L.at

Cash / Assets=(cashflow+che) / at

Tangible / Assets=ppent / at

Market-to-book Ratio = (at-ceq+csho*prcc_f)/at

Q= (at+csho*prcc_c-ceq-txdb)/(0.9*at+0.1*(at+csho*prcc_c-ceq-txdb))

KZ Index $= -1.00 * \frac{ib+dpc}{L.ppent} + 0.283 * Q + 3.14 * \frac{dlt+dlcc}{dlt+dlcc+ceq} - 39.37 * \frac{dvc+dvp}{L.ppent} - 1.31 * \frac{che}{L.ppent}$

Equity Return= (prcc_f-L.prcc_f)/L.prcc_f and adjusted for cumulative adjustment factor if applicable

S&P Speculative-grade=1 if Standard & Poor's domestic long-term issuer credit rating is below or equal to BB+ for the firm at year t

S&P Speculative-grade=0 if Standard & Poor's domestic long-term issuer credit rating is above or equal to BBB- for the firm at year t

12 industry classification: definitions are available from Ken French's website:

http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

C Bond Contract Terms

- Call Provision: a flag denoting that a bond has a call provision associated with it
- Coupon: the applicable annual interest rate that the bond's issuer is obligated to pay the bond holders
- Covenant: a flag denoting that a bond has covenants associated with it
- Covenant Count: the exact number of covenants associated with a bond
- Maturity at Issuance: year to maturity of the bond at issuance
- Offering Amount: the total principle value of bond initially issued
- Protection Period: number of months from issuance day a firm has to wait to be able to call an outstanding bond
- Protection Period ratio: the ratio of protection period to maturity at issuance
- Speculative-grade=1 if first rating is below or equal to BB+ for a bond
- Speculative-grade=0 if first rating is above or equal to BBB- for a bond
- Security Level: indicates if the security is a secured, senior, or subordinated issue of the issuer

D Covenant Terms:

- Negative Pledge Clause: indicates a covenant whereby the company is prohibited from pledging or placing liens on certain assets
- Change of Control: indicates the existence of a provision that allows for the redemption of the bonds or loans in the event of a corporate takeover, merger, or anti-takeover restructuring that would dissolve significant corporate assets
- Limit of Indebtedness Covenant: Indicates a negative or restrictive covenant that places limitations on the amount of debt that the issuer can incur. This can be expressed as a percentage of assets or in monetary terms

- Cross Default Covenant: indicates a stipulation stating that if an issuer is in default on other borrowings, such non-payment is also considered default in respect to the issue with the cross-default covenant

- Sales of Assets Restriction Covenant: indicates a negative or restrictive covenant that limits the ability of the issuer to sell any or all of its assets

- Debt Service Coverage Ratio Covenant: indicates cash available for total debt service or senior debt service. In corporate finance, it is the amount of cash flow available to meet annual interest and principal payments on debt, including sinking fund payments

- Rating Trigger Provision: indicates a clause that gives a put option to the bond holders if the bond falls below a designated credit rating, usually investment grade

- Merger Restrictions Covenant Indicator: indicates a negative or restrictive covenant placed on the issuer, stating that the issuer may not merge or consolidate with any other entity without satisfying certain conditions

- Limitation on Sales and Leaseback Covenant: indicates a restrictive or negative covenant that prevents the issuer from selling assets (or removing them from the balance sheet for accounting purposes) and then leasing them back from the company to which they were sold

- Limitation on Subsidiary Debt Covenant: indicates a negative or restrictive covenant that places limitations on the amount of debt that the issuer's subsidiaries can incur. This can be expressed as a percentage of assets or in monetary terms

- Restricted Payments Covenant: indicates a negative or restrictive covenant that limits an issuer's ability to make distributions, whether in the form of cash, assets, or securities to shareholders, to redeem subordinated debt, repurchase equity, or provide dividends

E IV Regression Specifications

Two instruments and two instrumented variables

$$Maturity_{i,t} = \delta_0 + \delta_1 D(\widehat{Early\_refi})_{i,t} + \delta_2 D(Early\_refi)\widehat{*D}(speculative)_{i,t} + \delta_i controls_{i,t} + \varepsilon_{it} \quad 2_{nd}\ stage$$

$$D(Early\_refi)_{i,t} = \beta_0 + \beta_1 Instrument_{i,t} + \beta_2 Instrument_{i,t} * D(speculative)_{i,t} + \beta_i controls_{i,t} + e_{it} \quad 1_{st}\ stage$$

$$D(Early\_refi)_{i,t} * D(speculative)_{i,t} = \theta_0 + \theta_1 Instrument_{i,t} + \theta_2 Instrument_{i,t} * D(speculative)_{i,t} + \theta_i controls_{i,t} + e_{it} \quad 1_{st}\ stage$$

Table A. 1: Firm Characteristics by Choice of Call Provisions

This table presents a comparison of firm characteristics for speculative-grade firm-year observations based on their choices of call provisions. $D(Call\ Provisions)$=1 indicates that a firm only issue callable bonds in that fiscal year. $D(Call\ Provisions)$=0 indicates a firm issues bonds without call provisions in that fiscal-year. Two sample t-tests are conducted by grouping observations across years together.
*** significant at 1% level. ** significant at 5% level. * significant at 10% level.

Variable	**D(Call Provisions)=0**	**D(Call Provisions)=1**	**0-1**	**P-value**
Log(Assets) ($Mils)	8.26	7.07	1.19***	0.00
Book Leverage	0.69	0.69	0.00	0.87
Market/Book	1.46	1.48	-0.02	0.78
EBITDA/Assets	0.11	0.11	0.00	0.68
Cash/Assets	0.08	0.08	0.00	0.64
Tangible/Assets	0.43	0.40	0.03	0.14
Equity Return	0.16	0.26	-0.10*	0.09
KZ Index	-2.13	-2.37	0.24	0.90
Q	1.36	1.34	0.02	0.59
S&P Rating	12.75	13.81	-1.06***	0.00

Table A. 2: The Determinants of the Protection-Period Setting

This table presents the results from a regression of a bond's protection-period ratio on various bond characteristics, firm characteristics at issuance, and interest rate controls at issuance. The dependent variable protection-period ratio is the ratio of the protection period to maturity at issuance. For example, if maturity at issuance is 10 years and the protection period lasts five years, the protection period ratio is 50%. Bond characteristic controls include offering size, coupon, seniority level, covenant counts, bond rating, and maturity at issuance. Firm characteristic controls include Ln(Assets), book leverage, EBITDA/Assets, Cash/Assets, Tangible/Assets, Market/Book, equity return, and S&P long-term rating. Interest rate controls include 3-month T-bill rate, term spread (10-year corporate yield minus 1-year corporate yield), and BAA-AAA. Sample firms are restricted in the speculative-grade firms. Firm fixed effect is included. Standard errors are clustered by firm.
*** significant at 1% level. ** significant at 5% level. * significant at 10% level.

	Dependent Variable: Protection Period Ratio	
	(1)	(2)
Log(Asset)($Mils)	-0.004	-0.004
	(0.007)	(0.007)
Book Leverage	0.003	0.005
	(0.041)	(0.041)
EBITDA/Assets	0.019	0.020
	(0.045)	(0.045)
Market/Book	-0.000	-0.001
	(0.008)	(0.008)
Cash/Assets	-0.013	-0.011
	(0.052)	(0.052)
Tangible	-0.011	-0.010
	(0.052)	(0.053)
Equity Return	-0.002	-0.003
	(0.003)	(0.004)
S&P rating	0.001	0.001
	(0.003)	(0.003)
3-month T-bill Rate		0.004
		(0.005)
BAA-AAA		0.003
		(0.012)
Term Spread		0.007
		(0.008)
Constant	0.437***	0.415***
	(0.111)	(0.110)
Firm FE	Y	Y
Bond Characteristics Controls	Y	Y
R-squared	0.445	0.445
N	2363	2363

Table A. 3: Conditional Firm Characteristics by $D(turn\_callable)$

This table presents the firm characteristic summary by comparing speculative-grade firm-year observations conditional on the $D(turn\_callable)$ switching from 0 to 1. Within each firm, only the paired observations with $D(turn\_callable)$ switching from 0 to 1 are included. $D(turn\_callable)$=1 indicates some bond(s) are scheduled to become callable in that firm-year. $D(turn\_callable)$=0 indicates no bonds are scheduled to become callable in that firm-year. Two sample t-tests are conducted by grouping observations across years, together with P-values presented.
*** significant at 1% level. ** significant at 5% level. * significant at 10% level.

Variable	**D(turn_callable)=0**	**D(turn_callable)=1**	**0-1**	**P-value**
Log(Assets) ($Mils)	6.99	7.00	-0.02	0.73
Book Leverage	0.56	0.55	0.00	0.86
Market/Book	1.36	1.38	-0.02	0.48
EBITDA/Assets	0.11	0.12	0.00	0.49
Cash/Assets	0.06	0.07	0.00	0.36
Tangible/Assets	0.40	0.40	0.00	0.90
Equity Return	2.29	0.81	1.48	0.43
KZ Index	0.43	0.56	-0.13	0.71
Q	1.29	1.29	-0.01	0.76
S&P Rating	14.07	14.01	0.06	0.59

Table A. 4: IV Strategy with ITT

This table presents the IV results, where $D(Early\_refi)_{i,t}$ is instrumented by $D(turn\_callable\_predicted)_{i,t}$, a dummy variable indicating that some bonds are scheduled to become callable in year t for firm i. For all bonds in the sample, the protection periods are set to be 50% of maturity at issuance. Two measures of maturity are used: F(Debt$\geq 5Y$) is the fraction of book debt with maturity of five years or longer, and Bond Maturity is the average bond maturity. Observations are at the firm-year level. Firm characteristic controls include Ln(Assets), book leverage, EBITDA/Assets, Cash/Assets, Tangible/Assets, Market/Book, equity return, and S&P long-term rating. Interest rate controls include 3-month T-bill rate, term spread (10-year corporate yield minus 1-year corporate yield), and BAA-AAA. Sample firms are restricted in the speculative-grade firms. Standard errors are clustered by industry-year.
*** significant at 1% level. ** significant at 5% level. * significant at 10% level.

$$D(Early\_refi)_{i,t} = \beta_0 + \beta_1 D(turn\_callable\_predicted)_{i,t} + \sum_j \beta_j controls_{j,i,t} + e_{i,t} \qquad 1st\ \ stage$$

(a) IV Strategy First Stage with ITT

	(1) D(Early_refi)	(2) F(Early_refi)
D(turn_callable_predicted)	0.086***	0.035***
	(0.014)	(0.009)
Firm FE	Y	Y
Year FE	Y	Y
Controls	Y	Y
Sample	Speculative	Speculative
R-squared	0.096	0.061
N	4223	3907

(b) IV Strategy Second Stage with ITT

	F(Debt≥5Y)		Bond Maturity	
	(1)	(2)	(3)	(4)
	OLS	IV	OLS	IV
D(Early_refi)	0.103***	0.726***	1.137***	5.248***
	(0.013)	(0.192)	(0.079)	(1.286)
F-stat (1st stage)		40.24		39.85
Firm FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Firm Controls	Y	Y	Y	Y
Interest Rate Controls	Y	Y	Y	Y
Sample	Speculative	Speculative	Speculative	Speculative
R-squared	0.147	-0.738	0.351	-0.994
N	3599	3542	4209	4134

Table A. 5: IV Strategy 2 Results

This table presents the IV results where $D(Early\_refi)_{i,t}$ is instrumented by the interaction between the callable fraction and BAA-AAA. Two measures of maturity are used: F(Debt$\geq 5Y$) is the fraction of book debt with maturity of five years or longer, and Bond Maturity is the average bond maturity. Observations are at the firm-year level. Firm characteristic controls include Ln(Assets), book leverage, EBITDA/Assets, Cash/Assets, Tangible/Assets, Market/Book, equity return, S&P long-term rating, and the callable fraction. Interest rate controls include 3-month T-bill rate, term spread (10-year corporate yield minus 1-year corporate yield), and BAA-AAA. Sample firms are restricted in the speculative-grade firms. Standard errors are clustered by industry-year.
*** significant at 1% level. ** significant at 5% level. * significant at 10% level.

$$D(Early\_refi)_{i,t} = \beta_0 + \beta_1 F(callable)_{i,t} * BAA - AAA_t + \beta_2 * F(callable)_{i,t} + \beta_3 * BAA - AAA + \sum_j \beta_j controls_{j,i,t} + e_{i,t} \quad 1st\ stage$$

$$Maturity_{i,t} = \delta_0 + \delta_1 \widehat{D(Early\_refi)}_{i,t} + \beta_2 * F(callable)_{i,t} + \beta_3 * BAA - AAA + \sum_j \delta_j controls_{j,i,t} + \varepsilon_{it} \qquad 2nd\ stage$$

(a) IV Strategy 2 First Stage

	(1)	(2)
	D(Early_refi)	F(Early_refi)
F(callable)*BAA-AAA	-0.097***	-0.073***
	(0.019)	(0.015)
Firm FE	Y	Y
Year FE	Y	Y
Controls	Y	Y
Sample	Speculative	Speculative
R-squared	0.158	0.155
N	3905	3893

(b) IV Strategy 2 Second Stage

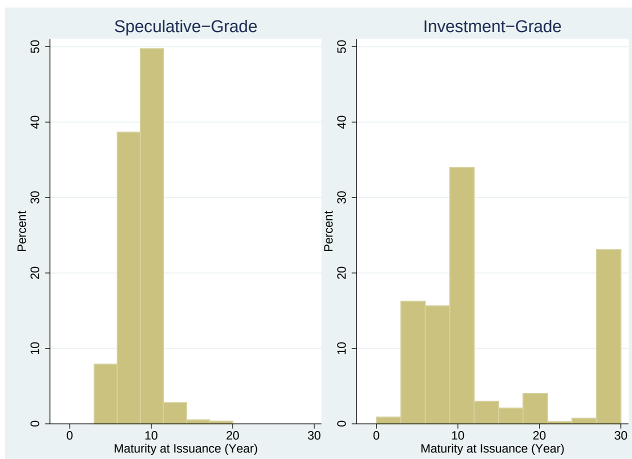
	F(Debt≥5Y)		Bond Maturity	
	(1)	(2)	(3)	(4)
	OLS	IV	OLS	IV
D(Early_refi)	0.151***	0.624***	1.411***	2.481***
	(0.018)	(0.202)	(0.082)	(0.516)
F-stat (1st stage)		36.69		27.61
Firm FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Firm Controls	Y	Y	Y	Y
Interest Rate Controls	Y	Y	Y	Y
Sample	Speculative	Speculative	Speculative	Speculative
R-squared	0.214	-0.214	0.418	0.395
N	3335	3335	3905	3905

Figure A. 1: Maturity at Issuance for Industries with Long Term Assets

The distribution of maturity at issuance is shown for speculative-grade and investment-grade firms' bonds in the Oil, Gas, and Coal Industry, and Telephone and Telivision Industry, along with a histogram for the distributions. Industry definition follows the Fama and French 12 industry category. For investment-grade firms, bonds with maturity at issuance longer than 30 years are included in the 30-year category in the histogram.

Industry	Rating	Mean	Std	P25	P50	P75	Max
Oil, Gas and Coal	Speculative-grade	8.6	2.1	7	9	10	20
	Investment-grade	14.6	11.9	7	10	20	100
Telephone and Telivision	Speculative-grade	8.8	2.1	7	10	10	30
	Investment-grade	16.2	14.2	5	10	30	100

(a) Oil, Gas and Coal Industry



(b) Telephone and Telivision Industry