Debt Issuance in the Era of Passive Investment*

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Abstract

Bond ETFs and other passive bond investment funds provide predictable demand for newly issued corporate bonds included in popular bond indices. By issuing index-eligible bonds, firms can take advantage of this passive demand, securing lower spreads and improving other bond contract terms unrelated to index eligibility. Consistent with this prediction, we find that higher passive demand increases firms' propensity to issue bonds, and results in larger bonds with lower spreads, longer maturities, and fewer covenants. Firms issue a disproportional number of bonds with face value just sufficient to be included in popular bond indices. Following an increase in the index size threshold, some firms withdraw from the bond market while others respond by issuing larger bonds.

Keywords: Debt financing; Corporate bonds; Passive investment; ETFs

JEL Classification Numbers: G32

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Introduction

Recent decades have seen a dramatic shift towards low-cost passive investment strategies, with passive funds now managing approximately 20% of aggregate investment assets (Sushko and Turner, 2018). Exchange-traded funds (ETFs) and other passive investment vehicles typically track various market indices and do not attempt to identify potentially mispriced securities. The trend towards passive index tracking has affected not only equity markets but also the corporate bond market, where bond ETFs and passive bond funds have attracted significant interest from investors. The inflow of money into such funds now provides predictable demand for corporate bonds at issue as long as they meet certain criteria (such as the minimum issue size) that make them eligible for automatic inclusion in popular corporate bond indices. This passive demand from index trackers may be insensitive to bond yields, covenant protection, and other bond characteristics unrelated to index eligibility.

This paper looks at how passive demand affects corporate bond issuance. We first document that firms take advantage of passive demand by issuing index-eligible bonds with favorable characteristics. Specifically, we show that higher demand from passive bond index trackers increases firms' propensity to issue bonds, and is associated with larger bond issues, lower yield spreads, fewer covenants, and longer maturities. Bond features undesirable for investors but irrelevant for index inclusion become more prevalent as passive demand for index-eligible bonds increases.

These findings are consistent with a model in which, in addition to active investors who make lending decisions based on their evaluation of expected default losses, there is also a number of passive investors who buy all bonds eligible for index inclusion. In the model, higher passive demand results in larger issue sizes, lower spreads, and higher investment. The effect is predicted to be particularly pronounced for firms that would normally choose to issue bonds with a face value somewhat below the threshold size required for indexing. In the presence of passive demand, such firms may decide to increase the bond issue size just enough to meet the index threshold requirement. By doing so, they can ensure

the participation of passive investors, which allows them to issue bonds on better terms and to reduce their cost of capital. Consistent with this prediction, we find that firms issue a disproportionate number of bonds that just meet the criteria for inclusion into popular indices tracked by passive bond funds. Specifically, bond issuance clusters at the minimum index size threshold, and while slightly larger bonds are not uncommon, slightly smaller ones have become exceedingly rare with the rise of passive bond index tracking.

To establish a causal link between passive demand and bond issuance, we look at the effects of *changes* in bond index eligibility requirements. We find that when index providers raise the minimum bond size required for index inclusion, firms respond by issuing larger bonds and clustering at the new, higher threshold. The effect is particularly pronounced for those firms which, absent the change, would be likely to issue a bond slightly below the new threshold. At the same time, we show that an increase in the index threshold temporarily reduces firms' propensity to issue bonds. Thus, rather than issuing a bond large enough to be eligible for indexing under the new rules, or selling a smaller bond that cannot take advantage of passive demand, some firms react to the tightening of index rules by abstaining from bond issuance altogether.

Overall, our findings suggest that passive demand for corporate bonds affects firms' debt financing decisions, bond contract terms, and the cost of capital. It incentivizes firms to issue larger bonds than they would otherwise, while simultaneously allowing them to pay lower spreads and secure more favorable bond terms along the dimensions irrelevant for index inclusion. In our model, this behavior has real consequences, as firms take advantage of the availability of cheap bond financing to increase investment.[1]

To the best of our knowledge, our paper is the first to explore financing implications of the rise of passive investment strategies in the corporate bond market. A number of papers have studied the effects

[1]Although a study of the real effects of passive bond demand is beyond the scope of this paper, we would nonetheless expect looser bond terms to result in a relaxation of constraints on investment. For example, covenants have been shown to constrain investment (Chava and Roberts, 2008). Thus, by allowing firms to issue bonds with fewer covenants, passive bond demand is likely to have real effects.

of 'nonfundamental investor demand' (Graham and Leary, 2011) on firms' capital structure decisions.[2] We contribute to this literature by showing how the presence of passive bond investors affects firms' debt issuance activity.

A sizable literature explores various implications of the secular shift toward passive investment strategies, indexing, and ETFs, including its effect on market efficiency (Stambaugh (2014), Wurgler (2011), and Israeli et al. (2017)), market fragility and volatility (Ben-David et al., 2018), underlying correlations (Da and Shive, 2017), trading liquidity (Hamm, 2014), corporate governance (Appel et al., 2016), and corporate investment (including Massa et al. (2005) and Li et al. (2018)). These studies have focused exclusively on passive demand in public equity markets, whereas we look at the demand for corporate bonds. What makes bond issuance decisions particularly interesting in this context is that, compared with equities, firms can more precisely adjust different bond features to meet index eligibility criteria. In addition, firms may also adjust bond characteristics that are important for the firm (such as spread) but not for the passive bond funds' decision to invest.

Only a few papers have studied the effects of corporate bonds' inclusion in tracked bond indices. Dannhauser (2017) examines the effects of ETF ownership on bond yields by looking at changes to Markit iBoxx bond indices rules. Dick-Nielsen and Rossi (2017) estimate the cost of liquidity in corporate bonds using index exclusions as a laboratory. Chen et al. (2014) look at a change in rating calculations by the Lehman Brothers bond indices (now the Bloomberg Barclays indices) and the effect on bond yields. All of these papers look at bonds that are already outstanding when index rules change. By contrast, we focus on the corporate finance implications of passive demand, investigating its effect on firms' decisions to issue bonds and on the resulting bond characteristics in the new issuance market.

[2]See Baker (2009) and Graham and Leary (2011) for reviews of recent capital structure literature. Note that the existing literature sometimes refers to the effects of this 'nonfundamental investor demand' as 'supply-side effects' in capital structure. In this paper, we refer to *investors' demand* for bonds and *firms' supply* of bonds.

1. Hypothesis development

In this section we show how the structure of investors' demand for bonds may affect firms' issuance decisions. We distinguish between 'active' bond investors, who decide whether or not to buy a bond based on their evaluation of expected default losses, and 'passive' investors, who invest in each bond regardless of its characteristics as long as the bond's face value is large enough for it to be included in a tracked index. We use the following simple model to illustrate the intuition and guide our empirical tests.

1.1. Model setup and the demand for bonds

A firm is considering raising funds in the corporate bond market for one period, and needs to choose the size of the bond to issue. The risk-free interest rate is zero, so that the bond interest rate coincides with the bond spread. For reasons that will be described shortly, in order to sell a bigger bond the firm needs to pay a higher spread; in other words, it faces an upward-sloping demand for bonds in the bond size/spread space. All bond characteristics other than size and spread are treated as given.

Denote by $s(D)$ the inverse bond demand function (the spread at which investors will agree to purchase a bond with a face value of D, given the firm's credit risk and other relevant parameters). The firm invests all funds raised by selling the bond under the production function $f(D)$, and pays $s(D)D$ in interest. To sell the bond, the firm must pay c in transaction costs. The firm chooses the face value D to maximize $f(D) - (1 + s(D))D - c$. If the above expression is never positive (for example, because transactions costs c are higher than potential profits), the firm eschews the bond market and does not invest.

The upward-sloping bond demand schedule arises as follows. There is a continuum of active bond investors, each of which can invest one dollar in the firm's bond.[3] The investors differ in their assessment of the (risk-neutral) expected loss from default, and given the firm's and bond's characteristics, an active

[3]The assumption that each investor can only invest one dollar ensures that in order to sell a large bond the firm must attract a sufficient number of investors with diverging views of its prospects. It may be justified by introducing investors' borrowing constraints or portfolio diversification requirements.

investor invests in the bond if his or her estimate of the loss from default does not exceed the offered bond spread. Denote by $F(s)$ the number of active investors whose estimate of the risk-neutral expected loss is below s and assume that F is monotonically increasing. Thus, if the firm wants to issue a bond with the face value D and there are only active bond investors present, the lowest spread that will allow it to sell the whole issue can be found from $F(s) = D$, giving rise to an increasing inverse demand function $s(D) = F^{-1}(D)$. Intuitively, when faced with active investors with heterogeneous beliefs, in order to sell a larger bond the firm needs to attract more pessimistic investors, who require higher bond spreads to offset their default expectations.

In the presence of passive bond funds, in addition to the active investors there are also P passive investors who will buy the firm's bond regardless of the spread provided that the issue is of sufficient size to make it eligible for an index inclusion. Denote the size threshold for index eligibility as $\bar{D}$. Thus, passive investors invest P dollars in the bond at any spread if $D \geq \bar{D}$, and do not invest otherwise.

The resulting demand schedule is illustrated in Figure 1. Small issues ($D < \bar{D}$) must be sold to active investors only at the spread given by $s = F^{-1}(D)$. By contrast, for large, index-eligible issues ($D \geq \bar{D}$) passive investors automatically contribute P dollars, leaving only $D-P$ to be financed by active investors. This allows the firm to sell the bond at the reduced spread given by $s(D) = F^{-1}(D - P)$.

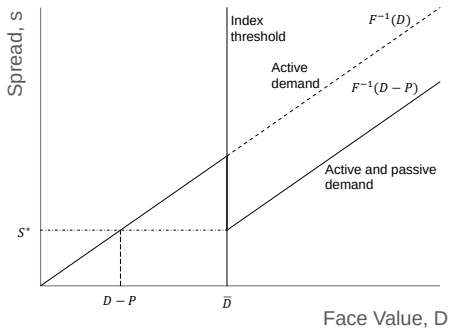


Fig 1. The bond demand curve.

1.2. Model predictions

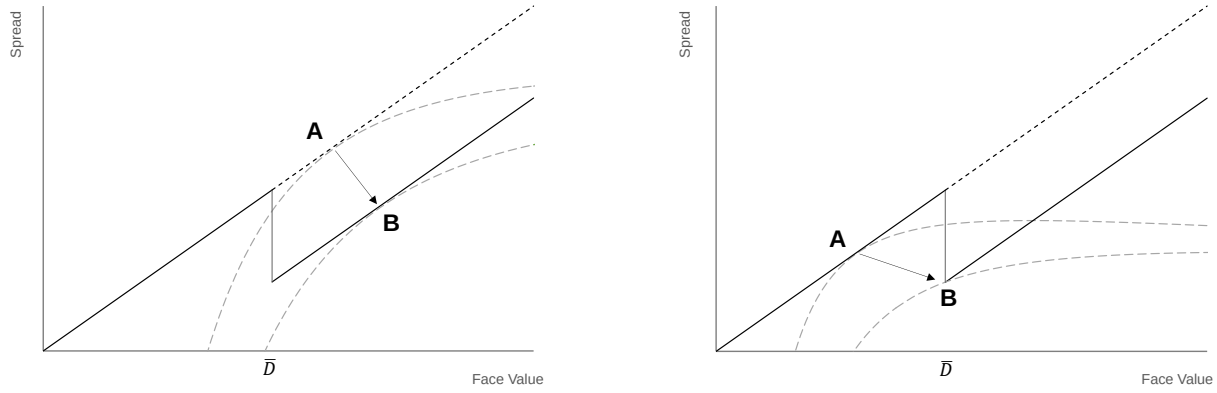
It is convenient to distinguish between cases in which the firm's optimal issue size in the absence of passive demand would be much smaller than $\bar{D}$, 'slightly' smaller than $\bar{D}$, or larger than $\bar{D}$. We refer to these cases as small, medium, and large target issue size cases. For small target issues ($D \ll \bar{D}$), passive demand is likely to be irrelevant for the firm's decision, and only active investors' demand needs to be considered. We will now show that, by contrast, for medium and large issues the presence of passive investors will in general result in larger issues and lower spreads.

Figure 2a illustrates the firm's decision when the target issue size is large, with each dashed line representing bond size/spread combinations that result in a particular level of profits for the firm net of debt costs.[4] In the absence of passive demand the firm's optimal choice would correspond to point A, which results in the highest profit attainable given the active-only demand curve for bonds. The presence of passive investors shifts the optimal choice to point B, at which the size of the issue is larger while the yield spread is lower. It is straightforward to show formally that for large issue sizes, under reasonable parameterizations of the relevant functions, the optimal issue size is increasing in the amount of passive demand, P, and the equilibrium spread is decreasing in it. Moreover, passive demand also increases the firm's propensity to issue bonds. Indeed, profits are strictly higher at point B than at A. Thus, there exists a range of parameters under which the cost of accessing the bond market, c, would deter bond issuance at point A, but not at point B.

Figure 2b demonstrates that for firms with a medium target bond size (i.e., those which in the absence of passive investors would choose the bond size slightly below $\bar{D}$), the introduction of passive investors may result in a corner solution, with the optimal bond size exactly equal to $\bar{D}$. In the graph, without passive investors the firm would choose point A below the index threshold. However, in the presence of passive demand the firm's profits are maximized at point B, i.e., at the issue size $\bar{D}$ just sufficient

[4]The firm's indifference curves are plotted assuming a square-root production function ($f = \sqrt{D}$) and linear demand from active investors.

to make the bond eligible for indexing. Thus, for a range of target issue sizes just below the index threshold, passive demand may induce firms to bump up their bond size to coincide with the threshold. While this bond size may be somewhat larger than ideal for these firms, the ability to take advantage of passive demand makes this choice worthwhile. Thus, the model predicts that a disproportional number of bonds should be issued exactly at the index threshold, and issues just below the threshold should be disproportionately infrequent.



(a) (b)

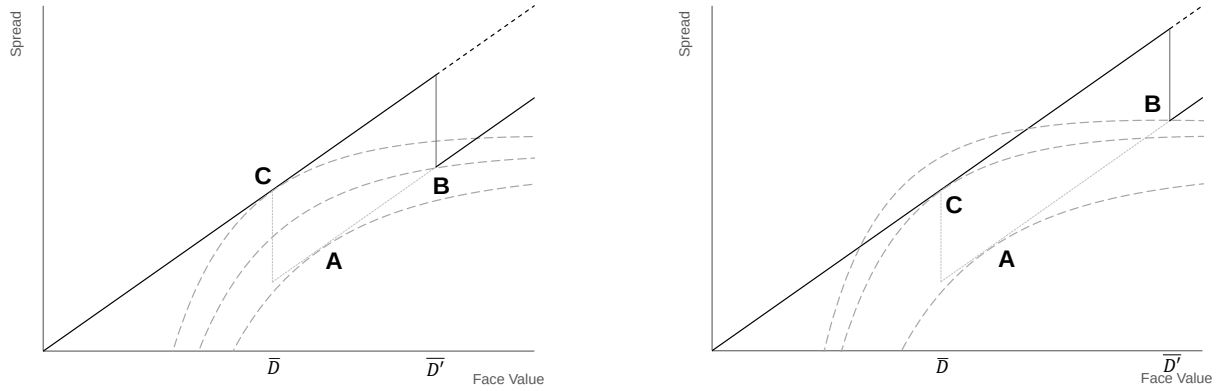
Fig 2. The effect of passive demand on firm's choice.

Now suppose that the index provider decides to increase the threshold size for index inclusion from $\bar{D}$ to $\bar{D}'$. This situation is depicted in Figure 3. Upon the threshold increase, a range of previously feasible size-spread combinations becomes infeasible. Specifically, firms that under the old threshold would optimally choose bond sizes between $\bar{D}$ and $\bar{D}'$ will no longer be able to do that while paying the same spreads as before, because bonds of this size are no longer bought by passive investors. As a result, these firms may decide to increase the bond size, decrease it, or abstain from bond issuance.

Consider the case depicted in Figure 3a. With point A no longer attainable, the firm chooses to switch

to point B (the new corner solution) and issue the bond at the new threshold size, $\bar{D}'$. Thus, following the threshold increase, firms with target issue sizes slightly below $\bar{D}'$ will cluster their issuance at the new threshold. However, because point B corresponds to lower expected profits,[5] for high enough costs of bond issuance the firm may decide not to issue the bond at all and forgo the investment. Thus, firms' propensity to issue bonds may decrease.

It is also possible that, rather than inflating the bond size to meet the new threshold, the new optimal choice for the firm would be to issue a *smaller* bond, relying only on active investors' demand. Consider the case illustrated in Figure 3b. As point A becomes unavailable, the firm's profits are maximized at point C, where it sells the bond to active investors only instead of inflating its size to meet the new indexing threshold.



(a) (b)

Fig 3. The effect of an increase in the index threshold.

Which of these two outcomes will prevail depends on how big the threshold increase is relative to passive investment P. By continuity, when point A in Figure 3a is sufficiently close to point B, reaching

[5]To see that point B yields lower profits than point A, notice that under the old threshold point A was preferred even though point B was also feasible.

for the new threshold will be optimal. But in general there may or may not be a region in which the bond will be sold to active investors only, as in Figure 3b. Nonetheless, in both cases profits at points B and C are unambiguously lower than at point A before the change.

To summarize, the model predicts that firms' propensity to issue bonds is positively related to passive demand, and decreases when the bond index provider raises the threshold size for index inclusion. Conditional on issuance, the bond size is increasing and the spread is decreasing in the amount of passive demand. Bond issuance by firms with medium target bond sizes clusters at the index threshold, with few issues just below it. When the threshold increases, firms with target bond sizes slightly below the new threshold issue larger bonds to meet the new requirement for inclusion, and the propensity to issue bonds decreases.

An important limitation of the above analysis is that all bond characteristics other than the bond size and spread are assumed to be fixed. In reality, all bond characteristics are determined jointly, including covenants, maturity, seniority, etc. An increase in the passive demand expands the set of feasible contracts in the firm's favor, because passive investors buy eligible bonds regardless of their creditor-unfriendly features. The resulting equilibrium thus corresponds to higher profits for the firm. This, however, does not imply that all bond features are necessarily adjusted in the firm's favor. For example, in the presence of passive demand a firm that finds covenants very undesirable may choose a new bond contract with less covenant protection, even if such a bond can only be sold at a higher spread. Theoretically, when the choice of multiple bond characteristics is modelled jointly, the resulting equilibrium will depend on the relationship between these characteristics and expected default losses, as well as on how costly the unfavorable bond terms (such as strict covenants or short bond maturities) are for the firm. Thus, with multiple choice variables the equilibrium effect is an empirical question, one that we turn to below.

2. Data description

In this section, we describe the data and key variables used in our empirical analysis. More details regarding the construction of the variables can be found in Appendix A.

Our tests employ both bond-level and firm-level data. Our first sample consists of corporate bonds included in Mergent's Fixed Income Securities Database (FISD). The second sample, which we use to study firms' propensity to issue bonds, consists of a broad set of Computat firms. We use various data sources, including CRSP Mutual Funds and index provider and fund websites, to construct our key independent variable related to passive demand for corporate bonds. In particular, we identify passive investment funds and the amount they invest in corporate bonds, as well as the composition and size of popular tracked bond indices and changes to eligibility criteria for those indices.

2.1. Sample selection

2.1.1. Corporate bond sample

In order to study corporate bond characteristics, we use a sample of newly issued bonds included in FISD. We eliminate issuance by government, financial and utility issuers; issuers not domiciled in the United States; bonds not denominated in USD; duplicate bonds;[6] convertible debentures, floating rate bonds, preferred shares and bonds issued as a part of a unit deal; and issues smaller than $25 million. The final sample includes 16,856 bonds issued by 3,615 unique issuers between January 1990 and September 2017.[7]

Our key variables of interest include the size (total face value) of the bond, the credit spread at issuance, the level of covenant protection, and the initial maturity, all taken from FISD. We estimate the strength of the covenant protection using a version of Moody's Covenant Quality Index. It is based on the number of covenants in the bond contract related to restricted payments, risky investment, debt

[6]For example, a registered bond that was originally issued as a Rule 144A bond and later exchanged would include two entries in FISD; we keep the original 144A bond in the sample but eliminate the bond into which it exchanges.

[7]We define 'issuers' in FISD at the agent_id level, which combines issuance up to the parent company level.

incurrence, lien subordination, and change of control. Our covenant score is a weighted average of covenants in these categories, and is normalized to fall between 0 (no covenants) and 1 (all possible covenants tracked by FISD).

To control for issuers' financial characteristics, we match FISD to Compustat and CRSP using issuer-level CUSIPs where possible, and by firm name otherwise. This procedure allows us to match approximately three quarters of our sample to Compustat. Where available, we include firm-level financial data from Compustat (from the quarter before issuance), and annualized daily volatility from CRSP. We winsorize all ratios at the 1% and 99% levels. We also include as controls macroeconomic variables such as the 10-year Treasury bond rate, the term slope between the 2-year and 10-year Treasury rates, and the spread between Baa and Aaa bonds, which we obtain from the Federal Reserve of St. Louis.

2.1.2. Firm sample

We study the effects of passive demand on the propensity to access the bond market using a sample of firms included in the U.S. Compustat database. After dropping financial and utility firms (sic codes 6000-6999 and 4900-4999, respectively), there are 16,267 unique firms and 652,027 firm-quarters between September 1989 and June 2017 (lagged one quarter from the issuance sample). We merge these data with the FISD database of bond issuance, and construct a dummy variable *issuer*, which takes on a value of 1 in a firm-quarter if in the next quarter the firm issues a bond meeting the criteria detailed in the previous section. In each firm-quarter, we calculate several financial variables of interest. We winsorize all ratios at the 1% and 99% levels.

In order to determine whether a bond from a potential issuer would be included in a particular investment grade (IG) or high yield (HY) index, we need to determine whether the bond would be rated IG or HY. For firm-quarters with at least one rated bond outstanding, we use the current median rating of the outstanding bonds in FISD to determine the likely rating for a hypothetical new issue. This variable, however, is not observed for firms without outstanding bonds. In these cases, we use the following

approach to estimate whether the issue would be likely to be rated IG or HY. Using the sample of FISD bonds with observed ratings, we regress the IG dummy on the five individual variables that comprise Altman (1968)'s z-score, and calculate the linear prediction from the fitted model. We then identify a cut-off prediction value that correctly classifies the highest number of firms as investment grade or not.

2.2. Measuring passive demand

We calculate our main variable of passive demand for bonds as the proportion of the index-eligible U.S. corporate bond universe that is held by passive funds. To this end, we apply index eligibility criteria to the universe of bonds in the FISD database, which allows us to estimate the fraction of the index attributable to corporate bonds. Using fund holdings data, we calculate the total assets in passive funds tracking each index, and then compute the amount of corporate bonds held by the funds. This subsection describes our approach in detail.

2.2.1. The bond indices

We use the CRSP Survivor-Bias-Free U.S. Mutual Fund database from January 1990 to September 2017 to measure passive investment in corporate bonds. We select funds that (i) invest at least part of their assets in U.S. corporate bonds and (ii) passively follow an index. In order to do this, we identify all funds with "Bond" and either "ETF", "Exchange Traded", "Exchange-Traded", or "Index" in the name. We then identify which index each of these funds follows using information from ETFdb.com and funds' online profiles. After removing all bond funds that do not hold U.S. corporate bonds (i.e, those investing in government, municipal, or foreign bonds only) as well as actively managed funds, we are left with 277 passive bond funds tracking 104 bond indices.

Many different indices are administered by a few major providers, as illustrated in Figure 4 separately for investment-grade (IG) and high-yield (HY) bond indices. Figure 4a shows that more than 80% of passive funds invested in investment grade corporate bonds follow indices provided by Bloomberg.[8] For

[8]Bloomberg bond indices were run by Lehman Brothers before November 2008, and subsequently by Barclays until August

high yield funds, Bloomberg indices are followed by net assets representing approximately 40% of high-yield bond funds, while about 50% follow Markit iBoxx indices (see Figure 4b). Based on these statistics, we limit our attention to Bloomberg and iBoxx indices. Specifically, we use the Bloomberg Barclays U.S. Corporate Index (IGCI) and the Bloomberg Barclays U.S. Corporate High Yield Index (HYCI) to identify the set of bonds eligible for indexing.[9] Most tracked indices are not exclusively focused on corporate bonds, and additionally include government, agency, and other bonds. For example, the popular Bloomberg Barclays U.S. Aggregate Index includes all bonds from IGCI, as well as Treasury, agency, non-U.S. government, and securitized bonds.[10]

We collect information on the composition of the relevant indices and the eligibility criteria that determine which bonds qualify for inclusion in each index. We record the history of major changes in the eligibility criteria, and use these rule changes in our test as quasi-natural experiments to identify the causal effects of passive index investment. Particularly important for our purposes are changes to the minimum face value for inclusion. Our model can have a direct impact on a firm's issuance decision and bond sizes. A detailed discussion of the major indices and changes in eligibility criteria can be found in Appendix B.

Based on the offering date of a bond and the relevant index, we calculate the difference between the bond size and the index threshold, *dist_to_threshold*. A negative value for *dist_to_threshold* means the issue is too small to qualify for the index, while a zero or positive value means the issue meets the size criteria.

2016.

[9] We use the Bloomberg index for high yield bonds due to a dramatic change to the index methodology used by iBoxx in 2009. See Appendix B for more detail.

[10] It should be noted that unlike equity index funds, bond index funds do not necessarily replicate the index they track. For example, according to its prospectus, the Vanguard Total Bond Market Index Fund "invests by *sampling* the Index, meaning that is holds a broadly diversified collection of securities that, in the aggregate, approximates the full Index in terms of key risk factors and other characteristics. All of the Fund's investments will be selected through the sampling process, and at least 80% of the Fund's assets will be invested in bonds held in the Index" (Vanguard, 2017).

2.2.2. Aggregate passive demand in corporate bonds

To compute the fraction of bond demand that is attributable to passive funds, we aggregate the funds' assets under management that are invested in U.S. corporate bonds and divide this amount by the total value of index-eligible bonds outstanding. Because index inclusion rules are different for investment grade and high yield bonds, we assign each bond to either the investment grade or high yield pool based on its initial rating and the rating criteria at the time of issuance. We do not classify bonds that do not have an initial rating. We estimate the proportion of corporate bonds held by passive funds as follows.

For each fund, the CRSP Mutual Fund database reports the total value of assets under management. Unfortunately, for most of the sample period there is no information on what proportion of their portfolio is in corporate bonds. For each fund, we infer this proportion by aggregating all bonds in the FISD database that are eligible to be included in the index tracked by the fund, and dividing the value of corporate bonds in the index by the total index size. To this end, for each bond (corporate or otherwise) in FISD we track key bond characteristics (including amount outstanding, rating and coupon status, as well as non-time varying characteristics) throughout the life of the bond. Each month, we determine which bonds are eligible to be included in each relevant index based on their characteristics, and then aggregate their outstanding amounts to find the total size of the index.[11] We then find the proportion of this value attributable to corporate bonds, and multiply the fund's assets under management to estimate the total dollar amount invested in corporate bonds by the fund. We aggregate these amounts across all passive funds to find our estimate of dollar passive bond demand. Finally, we divide this quantity by our estimate of the size of IGCI (HYCI) for investment grade (high yield, respectively) bonds to find the *proportion* of eligible corporate bonds that are held by passive funds. Thus, we obtain our main

[11] FISD does not track securitized bonds (such as asset-backed securities), which are included in a number of important bond indices. To correct for this omission, we adjust the corporate bond percentage down in the case of aggregate bond market indices. The monthly adjustment factor is based on relative total index face values of the Bank of America Merill Lynch Broad Market Index, which includes securitized bonds, and the U.S. Corporate and Government Index, which excludes them. This information can be obtained from a Bloomberg terminal (index tickers US00 and B0A0, respectively).

independent variable, *passive_demand_perc*.

Figure 5 shows the total net assets invested in U.S. corporate bonds.[12] Between 2009 and 2017, passive investment in investment grade and high yield U.S. corporate bonds has increased at compound annual growth rates of 26% and 34%, respectively. Figure 6 shows the proportion of outstanding corporate bonds held by passive funds. As of September 2017, we estimate that more than 5% of investment grade bond face value and more than 3% of high yield bond face value is held by passive funds. This is consistent with Sushko and Turner (2018), who estimate that 4.5% of all U.S. bonds are held by passive investment vehicles.

2.2.3. Bond-level passive demand

As described above, we construct two versions of the variable *passive_demand_perc*, which summarize passive demand for IG and HY bonds. In addition to these aggregate indices that only vary across time, we also compute a bond-level measure, *passive_demand_bond_perc*. This variable estimates the percentage of the given bond's total face value bought by passive funds, which allows us to exploit cross-sectional differences in passive demand arising due to bonds' varying eligibility for the 104 individual indices tracked by the 277 funds.

To construct this variable for a particular bond, we check if the bond meets the criteria to be included in the bond index tracked by each of the funds, and if it is, how much money the fund has invested in the bond, which we estimate based on the fund's total assets under management and the value weight of the bond in the index. The variable *passive_demand_bond_perc* is the fraction of the bond face value bought by all passive funds.

[12] As of the end of our sample period, there is an additional $517 billion invested in other bond types, such as government, agency and securitized bonds, and non-U.S. corporate bonds.

2.3. Descriptive statistics

Table 1 reports the descriptive statistics for our variables of interest: Panel A shows the statistics for our sample of bond issuers, while Panel B shows the statistics for the full Compustat sample. All variables are defined in detail in Appendix A.

The median new issue bond in our sample is $300 million in face value, and has a spread of 2.01%, an initial term of 10 years, and a covenant score of 0.09. The median bond issuer is investment grade rated (a value of 10 corresponds to BBB- or Baa3). In the Compustat sample, 1.4% of firm-quarters include at least one bond issuance, with a median offering size of $273 million.

Comparing the median bond issuer (Panel A) to the median Compustat firm-quarter (Panel B), the bond issuer has higher leverage, is larger in terms of book assets, is older, has more tangible assets, is more profitable, and has a lower q-ratio.

3. Passive investment, bond characteristics, and issuance

Our model predicts that as passive demand increases, firms issue larger bonds, either because firms 'reach' to be included in the index as in Figure 2b, or simply to take advantage of additional demand as in Figure 2a. At the same time, credit spreads are predicted to decrease. We also hypothesize that other bond characteristics irrelevant for index eligibility should be adjusted in the firms' favor as passive demand increases. To test these hypotheses, we use the FISD sample of bond issues, and estimate the following specification:

$$bondchar_{it} = \beta * passive\_demand\_perc_t + controls_{it} + \epsilon_{it}, \tag{1}$$

where $bondchar_{it}$ for bond i at time t is either the bond size (log_issue_size), the credit spread ($spread$), the level of covenant protection ($covenant\_score$) or the initial time to maturity ($initial\_maturity$). We expect the coefficient β to be positive for log_issue_size and $initial\_maturity$ and negative for $spread$ and $covenant\_score$.

Our main independent variable is $passive\_demand\_perc_t$, the fraction of indexed corporate bonds that is held by passive funds. This variable is measured at monthly frequency, separately for investment grade and high yield bonds. In all specifications, we use quarter fixed effects and industry fixed effects.[13] We control for bond rating, log assets, leverage, and other variables suggested by Graham and Leary (2011), as well as additional controls for macroeconomic conditions.[14] The results of the regressions are shown in Tables 2 and 3.

Consistent with the model's predictions, for all specifications in Table 2, passive demand for bonds is positively correlated with the size of bonds being issued and negatively correlated with the bond spread. The results are strongly statistically significant across all specifications. In addition, Table 3 shows that bond maturity is longer and covenant protection is lower when passive demand is high, though the latter correlation is only occasionally significant. The control variables work generally as expected. Larger firms issue larger bonds with lower spreads, fewer covenants and longer maturities; controlling for firm size, lower rated issuers are associated with larger offering sizes, higher spreads, more covenants and shorter maturities.

We next look at firms' propensity to issue bonds. Because bond contract terms are more favorable in the presence of passive demand, we hypothesize that firms should be more willing to issue bonds when passive demand is high. To test this hypothesis, we use a sample of Compustat firms, identify which of them issue bonds and which do not, and look at whether the probability of becoming a bond issuer is positively correlated with passive demand by estimating the following linear probability model:

$$issuer_{it} = \beta * passive\_demand\_perc_t + controls_{it} + \epsilon_{it}, \tag{2}$$

[13] For issuers in the Compustat database, we use the 2-digit SIC code to control for industry fixed effects. For specifications that use only FISD bond data, we use the industry code provided by FISD, which is as coarse as 1-digit SIC. In untabulated tests, we rerun all specifications using 2-digit SIC on the sample for which it is available, and results are similar.

[14] Unlike Graham and Leary (2011), we do not control for R&D expenditures because of the well-known problems with data availability in Compustat.

where $issuer_{it}$ is a dummy that takes on a value of 1 in quarter t that a firm i accesses the bond market, and 0 otherwise. We include quarter fixed effects across all specifications, and either 2-digit SIC or firm fixed effects. We also control for variables used in studies of firms' financing decisions, including log assets, leverage, investment grade dummy, the components of Altman (1968)'s z-score, and the variables used by Leary and Roberts (2005) in their study of firms' refinancing decisions. The results are given in Table 4. The coefficient on $passive\_demand\_perc_t$ is positive and strongly significant, indicating that higher passive demand is positively correlated with firms' propensity to access the bond market.

Thus, higher demand from passive bond investors makes bond issuance more likely, and conditional on issuance, it is associated with larger bonds, lower spreads, longer maturities, and fewer covenants.

As mentioned previously, our independent variable of interest in the previous tests, *passive_demand_perc*, differs for IG vs. HY issuers, but otherwise varies only over time and not across firms. We control for time variation in firms' issuing activity and bond features by including quarterly fixed effects and a number of macroeconomic variables. Nonetheless, there may be residual unobserved variation in economic conditions within each quarter that may be affecting our results.

To address this issue, we construct a bond-specific measure of passive demand, *passive_demand_bond_perc*. This variable exploits the fact that different bonds can be eligible for inclusion in different subsets of the 104 bond indices tracked by the passive funds, and thus bought by different funds. We re-run the bond characteristic regression as follows:

$$bondchar_{it} = \beta * passive\_demand\_bond\_perc_{it} + controls_{it} + \epsilon_{it},$$

where $passive\_demand\_bond\_perc_{it}$ now varies for bond i issued at time t.

The results are shown in Table 5. The results for the issue size and spread are similar to those found previously, with higher passive demand corresponding to bigger bonds and lower spreads. This is once again consistent with the model's predictions. In addition, we also look a the effect on covenants and bond

maturity. The coefficients for these variables flip signs compared to Table 3, although the relationship is statistically significant only for initial maturity.

As discussed previously, the model makes no predictions on how multiple bond characteristics will be adjusted under higher passive demand; we can only conclude that the overall bond package will be more attractive to the firm. The bond-level regression results concerning the effect on maturity suggest that not all bond features may be adjusted in the firm's favor. However, this result may also be a reflection of the fact that there are passive bond funds that are specifically tailored to invest in bonds of a particular maturity (such as 1-5 years, 5-10 years, or 10+ years). Since firms can influence inclusion in indices based on whether they meet the eligibility criteria, they may strategically choose a maturity to influence the amount of passive demand to which they are exposed. As a result, *passive_demand_bond_perc* is more endogenous than the time series variable examined in Tables 2 and 3, especially with respect to a bond's initial maturity.

Overall, the results on bond sizes and spreads are consistent with those of our main regressions, confirming that passive demand is related to bonds with terms that are attractive to issuers. To investigate whether these relationships are causal, we focus on effect that the threshold for index eligibility has on issuers' behavior.

4. Index eligibility thresholds

In this section, we show that bond issuance decisions are affected by the requirements that determine eligibility for inclusion in popular bond indices tracked by passive funds. Each index has a number of criteria for inclusion, such as credit grade (IG vs. HY), minimum face value, and specific bond features (e.g. the bond must have a fixed coupon and cannot be convertible). In our tests, we take the bond's IG/HY designation as given and focus on the minimum size (face value) requirement, because it is a characteristic most easily adjusted by the issuer. The size threshold differs for IG and HY indices and varies over time, allowing us to exploit changes in thresholds for identification purposes.

4.1. Threshold clustering

Our model predicts a 'corner solution' (illustrated in Figure 2b) for firms which, in the absence of passive investors, would issue bonds somewhat below the index threshold size. These firms may take advantage of passive demand by bumping up the issue size just enough for the bond to be included in the index. As a result, we expect bond sizes to cluster at the index size threshold, with few issues just below it.

Figure 7 illustrates this effect. It shows the distributions of 'target' bond sizes and the actually observed size, for investment grade bonds during the period when the IGCI threshold was \$250 million.[15] The graph demonstrates that, in contrast to the smooth distribution of target bond sizes, the actual distribution experiences a pronounced jump at the index threshold, with few firms issuing bonds below it.

To formally check whether the index thresholds are relevant, we employ the density test from McCrary (2008), which is often used in the regression discontinuity design (RDD) context to check for manipulation of the running variable. We expect bond total face value to be manipulated around the size threshold, so that the density of the distribution would be higher immediately to the right of the threshold than the left. The null hypothesis is that issuance is randomly assigned on both sides of the threshold.

Using the *dist_to_threshold* as the variable of interest, Figure 8 shows that there exists a sharp discontinuity to the left and the right of zero (i.e., at the threshold), with higher density to the right of the discontinuity than the left. This is the case for the full sample, the IG sample and the HY sample. These tests confirm that the distribution of issue sizes is discontinuous at the index threshold, consistent with our model's prediction of a corner solution at the threshold for a range of firms which in the absence of passive demand would issue a smaller bond not eligible for indexing.[16]

[15] Figure 7 is based on the sample of investment grade bonds issued between June 2005 and January 2017. The target issue size is the in-sample fitted value from the regression of the bond size on the firm's total assets, average rating, and quarter and industry fixed effects. It should be noted that the in-sample nature of the prediction biases it to be above the threshold, i.e., against finding the effects that we document.

[16] It is not surprising that we observe a discontinuity, since bond face values cluster in round dollar amounts (e.g. \$50 million increments) and the index thresholds always occur at such round amounts; it is for this reason that we do not try to

4.2. Threshold changes

In this section, we document the effects that *changes* in the index threshold have on firm's issuance decisions. Our tests focus on three major indices, changes to which would affect corporate bond holdings of over 95% of passive bond funds by value. These are the Bloomberg Barclays U.S. Corporate Index (IGCI) for investment grade bonds, and the Bloomberg U.S. Corporate HY Index (HYCI) and the Markit iBoxx Liquid High Yield Index (iBoxx) for junk-rated bonds.[17] During our sample period, which starts in 1990, the threshold for IGCI was updated five times, and each of the high yield indices was updated once. In addition, we look at the effect of the introduction of the iBoxx index in 2007.

Figure 9 plots the distribution of bond issue sizes in the 12 months before announcements of and 12 months after effective dates of threshold changes to IGCI. While the effect does not appear strong for the first two updates, in 1994 and 1999 (panels 9a and 9b), these took place before passive bond investment became significant. By contrast, Panel 9c, corresponding to two index threshold increases in October 2003 and July 2004, presents a clearer picture. In particular, each graph shows that issuance immediately to the left of the threshold is smaller than the issuance immediately to the right (with large spikes in the bottom two graphs). In addition, we do not see issuance concentration at cut-offs from other time points; for example, issuance in the $250 million bin is lower than the $200 million bin in all graphs except the bottom one, when the threshold increased to $250 million. The results are also clear in panel 9d, which shows the April 2017 increase in threshold from $250 million to $300 million. The bottom panel shows that in the six months after the effective date of the change, there is very little investment grade issuance at the $250 million level, while there was a healthy amount of issuance at that level in the six months before the change was announced.

apply tests that examine whether the distribution 'bunches' at the index threshold (for example, as in Chen et al. (2018)). However, we feel this test provides suggestive evidence consistent with our model prediction.

[17] Many funds track larger indices that IGCI as a subset. However, changes to IGCI eligibility criteria will be mirrored in all indices that use IGCI as the basis for selecting eligible corporate bonds (for example, the Bloomberg Barclays U.S. Aggregate Index, which consists of U.S. corporate bonds from the IGCI, as well as other type of bonds, such as government and agency).

Figure 10 shows the distributions for high yield bonds. We examine one change in the HYCI (increase from $100 million to $150 million in 2000) and two changes in the iBoxx (its introduction in 2007 with a $200 million threshold and an increase from $200 million to $400 million in 2009, along with other changes). Though the change to HYCI is early in the sample, there is a clear cluster immediately to the right of the threshold in both graphs.

The introduction of the iBoxx in Panel B appears to result in a decrease in bonds at the $150 million level relative to the $200 million level. However, the results are less clear when the index dramatically increased its threshold to $400 million, as there is some clustering at both the old and new thresholds before and after the change. The ambiguous effect of the doubling of iBoxx is in fact consistent with the predictions that our model makes for large index changes. Indeed, as illustrated in Figure 3b, a large increase in the index threshold may result in smaller bond sizes. In particular, a firm that under the old rules may have issued a $200 million bond to take advantage of passive demand, may find it unprofitable to issue a $400 million bond in order to reach for the new index threshold, and settles for a smaller issue size sold to active investors only.[18]

4.3. Regression analysis

To formally establish the effect that index changes have on bond size, we examine the index changes in a difference-in-difference framework. In particular, for changes in the investment grade index (IGCI), we compare bond issuance by IG (treated) versus HY (control) issuers before and after the index changes. Similarly, we examine changes in the HY indices using high yield and investment grade bonds as the treated and control groups, respectively. We are able to do this because none of the changes across both the IG and HY indices occur at the same time.

We first examine whether the treatment and control groups exhibit parallel trends before the 'shocks' to the respective index. Figure 11 shows the average offering size and issuance propensity before and after

[18]Note that such bonds would still be tracked by the funds following the HYCI, as long as the issue size is above $150 million.

each change, with the announcement dates marked by vertical lines (the 'pre' period is to the left of the lines). For the investment grade index changes (the top two panels), there appears to be a divergence in average bond sizes only in the months immediately before the fourth change. The issuance propensities move almost entirely in sync other than for the second change, where there appears to be an increase in high yield issuance immediately before the change. This change occurred in the middle of the dot-com bubble, which may have contributed to the observed trends. For the high yield index changes depicted in the bottom two panels, there may have been some divergence in average issuance size immediately before the second change, which occurred in April 2007. Overall, however, the parallel trends assumption appears to be generally satisfied.

Next, we estimate the following difference-in-difference regression for the changes to the investment grade index:

$$logamt_{itc} = \alpha * post\_ig_{itc} + \gamma * treated\_ig_{itc} + \beta * post\_ig_{itc} * treated\_ig_{itc} + \mu_c + controls_{itc} + \epsilon_{itc}, \quad (3)$$

where $post\_ig_{itc}$ is a dummy variable equal to zero in the period before a change in the investment grade index is announced and to one in the period after the change is implemented (the period in between the announcement and effective date is ignored), and $treated\_ig_{itc}$ is a dummy equal to one for investment grade issuers and zero for high yield issuers. Because we look at one-year time windows before and after each change and the changes are spread out in time, we are left with four mutually exclusive difference-in-difference cohorts, indexed by c.[19] By including cohort fixed effects (μ_c), β measures the average treatment effect across the four changes in a stacked difference-in-difference regression. As controls, we include industry fixed effects across all specifications; we also include log-assets and bond ratings in some specifications.

[19]We exclude the 'middle' period between the two consecutive changes in October 2003 and July 2004. The pre- and post-periods correspond to the top and bottom graphs in Figure 9c, ignoring the middle graph.

Similarly, we estimate the following regression for the two changes to the high yield indices:

$$logamt_{itc} = \alpha * post\_hy_{itc} + \gamma * treated\_hy_{itc} + \beta * post\_hy_{itc} * treated\_hy_{itc} + \mu_c + controls_{itc} + \epsilon_{itc},$$

where $post\_hy_{itc}$ is a dummy that is equal to zero in the period before a change in the high yield index is announced and one in the period after the change is implemented (ignoring the middle period for the iBoxx changes), and $treated\_hy_{itc}$ equals one for high yield issuers and zero for investment grade issuers. In both sets of regressions, we restrict our sample to bonds with a face value less than $1 billion, for which the index threshold is more relevant and closer to 'binding' (this does not materially affect the results).

Panel A of Table 6 shows the results of these regressions. Columns 1 and 2 pool all investment grade bond changes together, and show that investment grade bonds issued immediately after an investment grade index change are significantly larger, compared to the change in high yield bond issuance over the same period. The addition of controls has little effect on the coefficient or significance. Columns 3 and 4 pool all high yield changes together. In these regressions the coefficient on the interaction term is also positive, though not statistically significant. The lack of significance may be attributable to the fact that HY index changes occurred while passive investment in high yield bonds was still not as widespread.

As illustrated in the two panels of Figure 2, our model suggets that the effect of an index threshold increase may be different for firms based on their target issue size absent the threshold constraint. In particular, a firm who is not constrained by the index threshold (i.e., would optimally issue above the threshold) should increase the bond size by a smaller amount than a firm that would otherwise issue below the threshold. To examine this prediction, we estimate the 'target' bond issue size and test whether the threshold increase is more relevant for firms which would otherwise issue bonds below the new threshold. The results are reported in Panel B of Table 6. Using only bonds in the pre-change periods, we first predict the offering size of a bond based on the controls above (log assets, rating, and change and industry fixed

effects), and place the bond in one of two buckets: predicted bond size that is above the new threshold (columns 1 and 3), and predicted bond size is above the old threshold but below the new threshold (columns 2 and 4).[20] While we expect a positive β coefficient across all specifications (since the direction of the arrows in Figure 2 are both to the right), we expect a larger β for bucket 2 relative to bucket 1 as these issuers 'reach' to be included in the index in the post-change period but did not have to reach in the pre-change period. This is in fact what we find: the coefficient for investment grade issuers in bucket 2 is more than five times that of those in bucket 1, and the coefficient for high yield issuers is almost two and half times that for issuers in bucket 2 relative to 1.

Finally, we look at the effect that an increase in an index threshold has on the firms' propensity to issue bonds. We hypothesize that larger thresholds discourage bond issuance by putting passive demand out of reach for some firms that target medium-sized issues. These tests parallel those in Table 6, except that we replace *log_amount* with the the *issuer* dummy, and estimate the following specification:

$$issuer_{itc} = \alpha * post_{itc} + \gamma * treated_{itc} + \beta * post_{itc} * treated_{itc} + \mu_c + controls_{itc} + \epsilon_{itc}, \tag{4}$$

where $post_{itc}$ and $treated_{itc}$ represent either IG or HY index changes.

The results of this regression are shown in Table 7. We include change and industry fixed effects and the same controls as those included in the first and last two specifications of Table 4. In contrast to the long-term positive relationship between passive demand and issuance propensity, in the short term around index threshold changes, an investment grade firm's propensity to access the bond market is significantly reduced following a threshold increase. The results for high yield issuers are not statistically significant, which we believe are partly driven by the fact that the change in the Markit iBoxx index threshold occurred concurrently to the early growth in the junk bond market.

To summarize, an increase in the index eligibility threshold for investment grade firms reduces their

[20]There are too few bonds that fall into the third mutually exclusive category (predicted size falls below the old and new threshold) that inference is not possible. We exclude these bonds (44 for investment grade, 30 for high yield).

propensity to issue bonds, but for those firms that do end up issuing it results in larger bond size. These findings suggest that while some firms 'reach' to be included in the index, other firms are discouraged from issuance altogether given the options of either issuing a small bond that cannot take advantage of passive demand or a bond that is larger than their target issuance amount.

5. Conclusion

In this paper, we examine the effects of passive investment on firms' activity in the primary bond market. Investment in passive bond mutual funds and ETFs has increased drastically in the last decade, and many investment vehicles track a small number of bond indices that have well-known eligibility criteria. We show that, in order to be exposed to passive investment funds, firms issue bonds of sufficient size to be included in the index, with clustering at index thresholds. Higher passive demand increases firms' propensity to issue bonds in general, and firms are able to take advantage by improving bond terms that are irrelevant to index inclusion (but still important to bond investors), such as lower spreads, fewer covenants, and longer maturities. These results are consistent with a model in which passive investors automatically buy index-eligible bonds, leaving less to be financed by active investors who evaluate the bond's investment attractiveness based on its pricing and credit risk.

We establish a causal link between passive demand and bond issuance by examining activity in short windows around changes to eligibility criteria for popular bond indices. After an increase to the index threshold, firms' propensity to issue a bond is temporarily decreased, though firms that do access the market issue larger bonds that meet the new higher criteria. We also show that firms issue a disproportionate number of bonds precisely at the threshold with very few bonds immediately below it, and cluster at the new threshold when the index eligibility criteria are revised.

We have explored the impact of passive demand on bond issuance, an important financial activity, contributing to the literature on effects of the secular trend towards passive investment. An interesting extension would be the effect on real activities, such as firm investment. Other recent work on equity

ETFs explores how passive investment affects stock price informativeness and subsequent investment (Li et al., 2018). Our model and empirical results show that passive investment in bonds influences firms' cost of capital and access to bond markets, which has potential to be an even more important driver for firms' investment decisions. We speculate that increased passive investment facilitates access to financing and thus investment, though this may be temporarily disrupted for some firms, as shown by our results around index threshold changes. The differential impact among firms and over time is a potentially interesting area of research.

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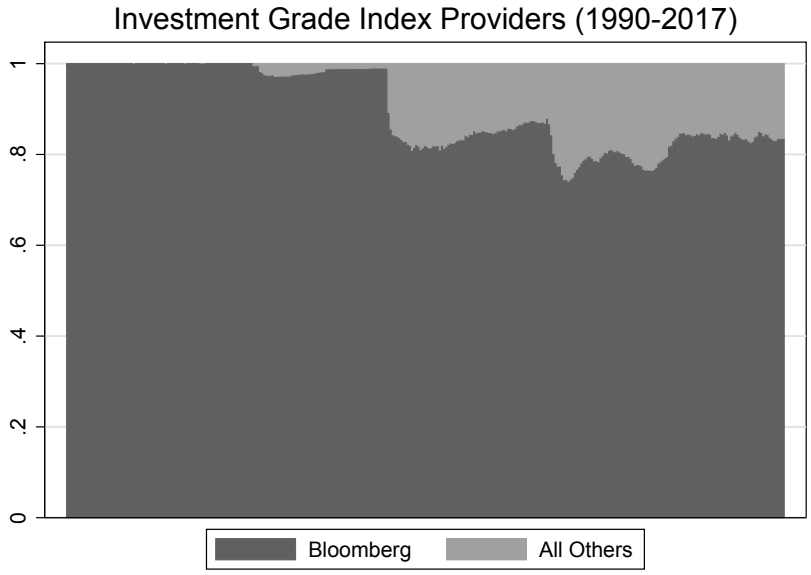

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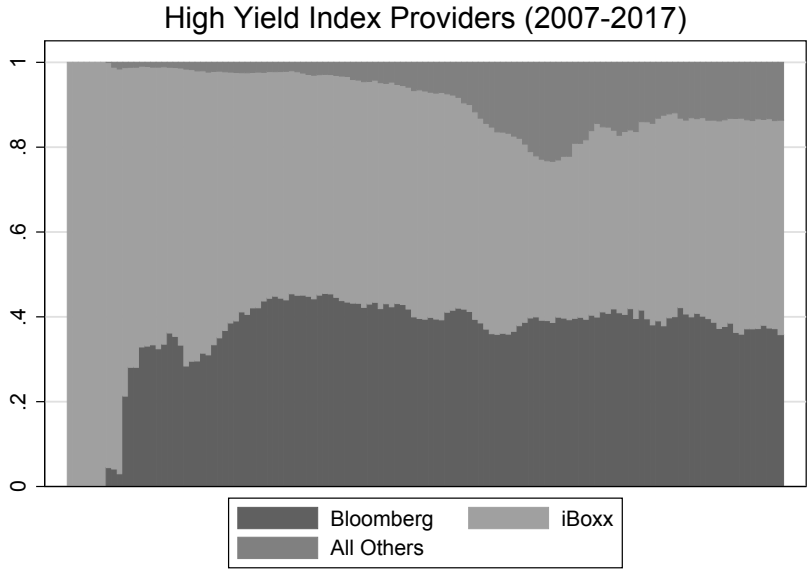


(b)

Fig 4. Proportion of total net assets following indices by Bloomberg, iBoxx and all other index providers combined.

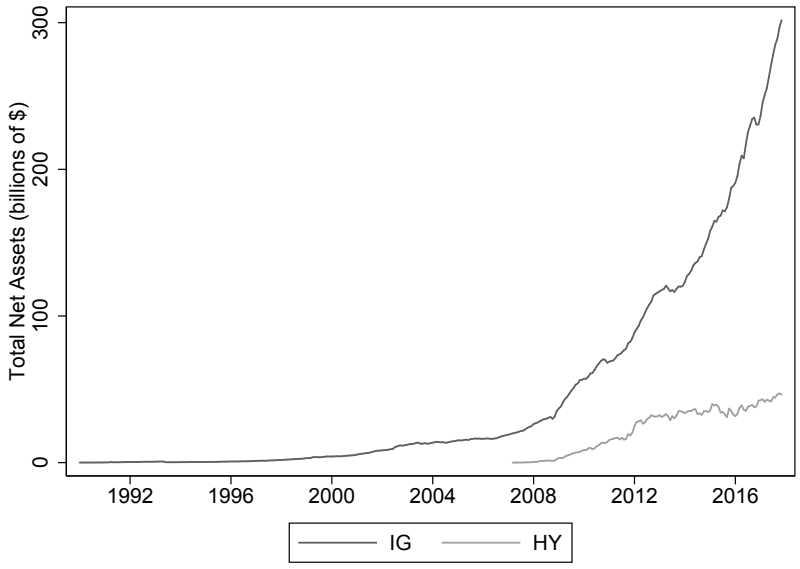


Fig 5. Monthly total net assets (in billions of US$) of passive funds invested in U.S. corporate bonds.

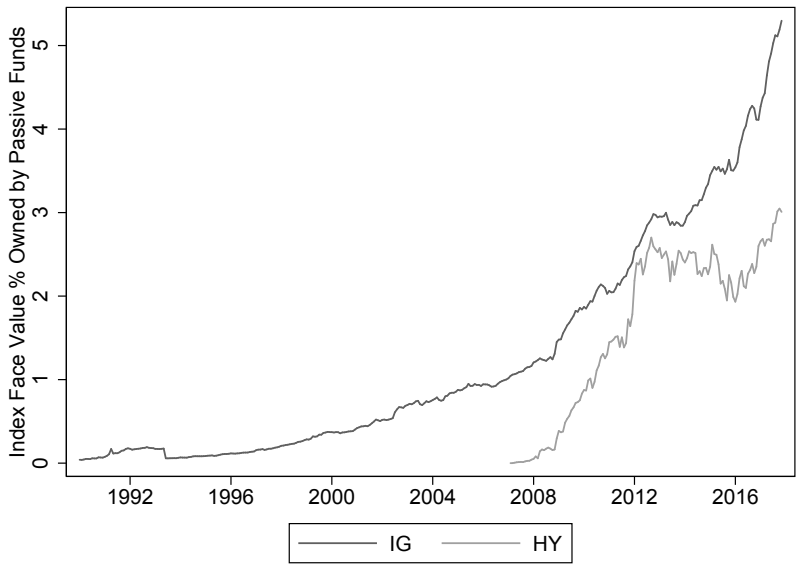


Fig 6. Monthly total net assets of passive funds invested in U.S. corporate bonds divided by the total face value of all bonds included in the relevant index. The investment grade index is the Bloomberg Barclays U.S. Corporate Index and the high yield index it the Bloomberg Barclays U.S. Corporate High Yield Index.

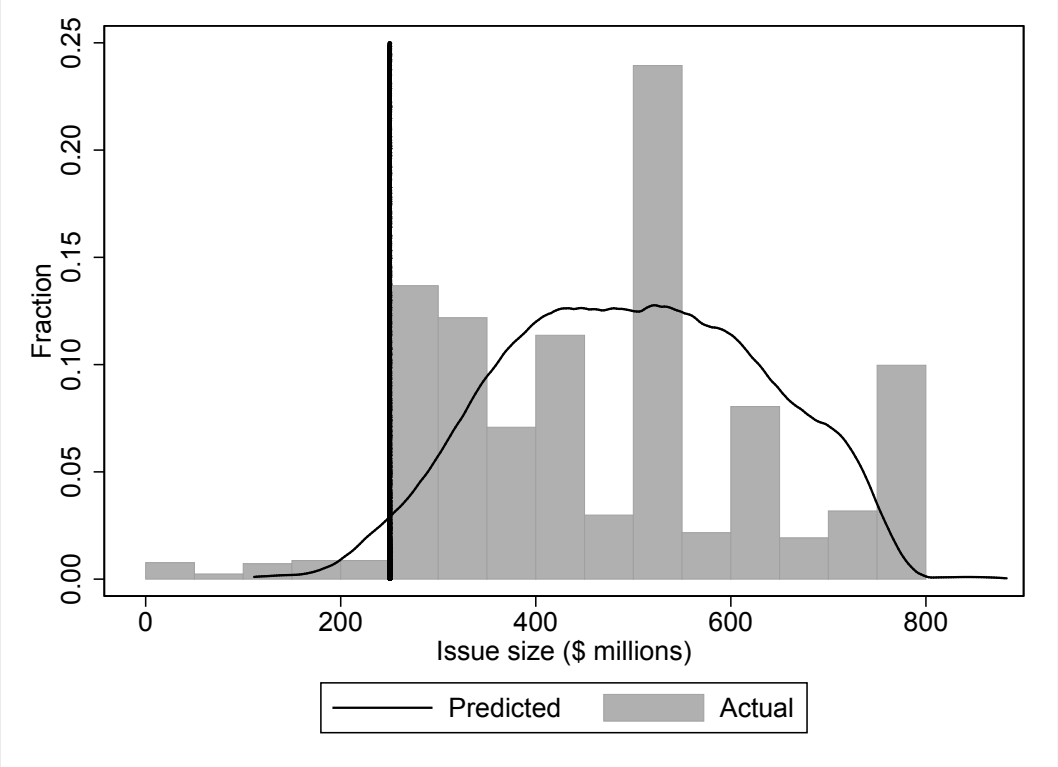
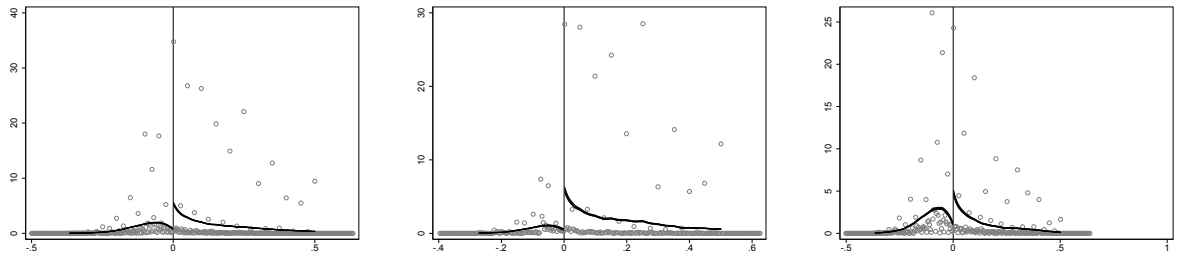


Fig 7. Histogram of actual investment grade issuance between June 2005 and January 2017, when the threshold for inclusion in the Bloomberg Barclays U.S. Corporate Index was $250 million (shown by the vertical line). Bins represent $50 million increments. Predicted bond sizes are estimated in-sample using log assets, bond rating, and quarter and industry fixed effects.



(a) (b) (c)

Fig 8. Results of the density test of McCrary (2008). The variable of interest is the *dist_to_threshold*, measured in billions of dollars, with a vertical line at $0 (or issuance at the threshold level). We include bonds within $500 million of the threshold. (a) Includes the full sample of bonds. (b) Sub-sample that includes investment grade bonds only. (c) Sub-sample that includes high yield bonds only.

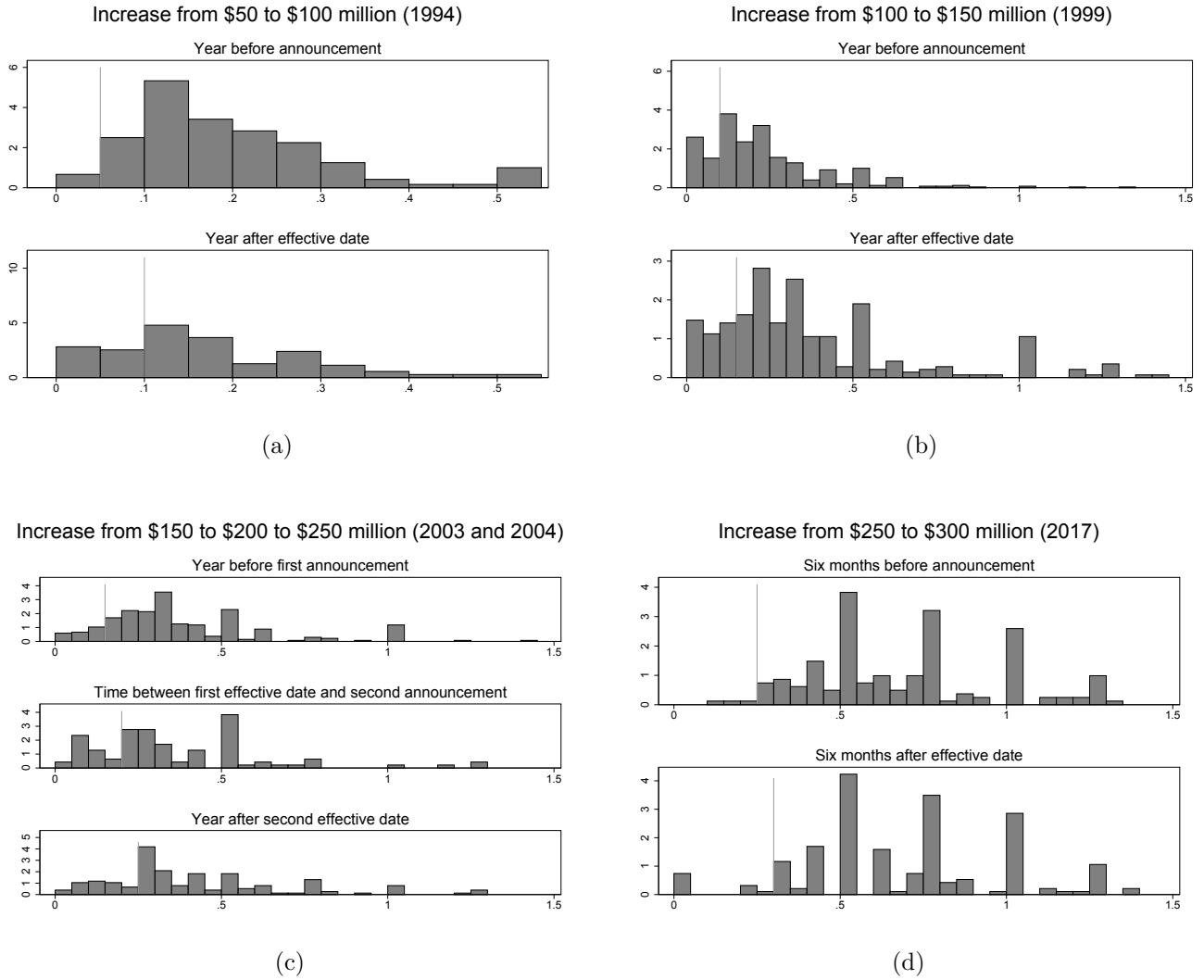
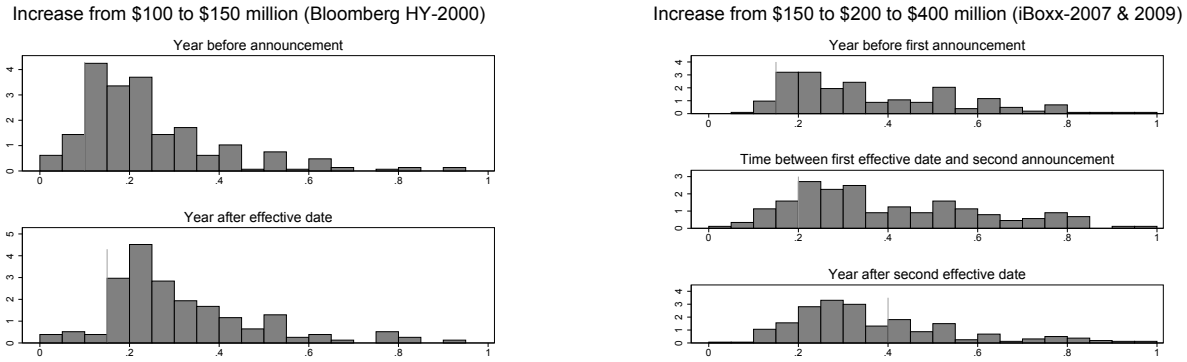
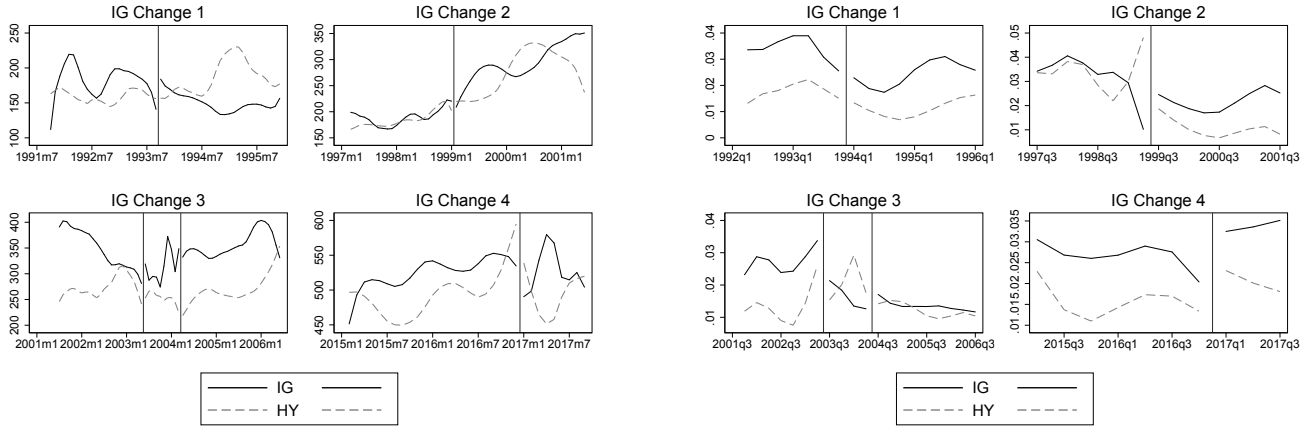


Fig 9. Histograms of investment grade issuance in short time frames before and after index threshold changes to the Bloomberg Barclays U.S. Corporate Index (excluding the time between announcement and effective date of the changes); only issuance up to $1.5 billion in face value shown. Each graph includes a vertical line at the issuance threshold of the time. Bins represent $50 million increments. (a) Change in index threshold from $50 to $100 million effective January 1, 1994 (assumed to be announced October 1, 1993). (b) Change in index threshold from $100 to $150 million announced February 24, 1999 (effective July 1, 1999). (c) Changes in index threshold from $150 to $200 million announced June 17, 2003 (effective October 1, 2003) and from $200 to $250 million announced March 18, 2004 (effective July 1, 2004). (d) Change in index threshold from $250 to $300 million announced January 24, 2017 (effective April 1, 2017).



(a) (b)

Fig 10. Histograms of high yield issuance in short time frames before and after index threshold changes (excluding the time between announcement and effective date of the changes). Issuance up to $1 billion in face value. Each graph includes a vertical line at the issuance threshold of the time. Bins represent $50 million increments. (a) Change in Bloomberg Barclays U.S. Corporate High Yield index threshold from $100 to $150 million effective July 1, 2000 (assumed to be announced April 1, 2000). (b) Introduction of Markit iBoxx Liquid HY index in April 2007 (assumed to be announced April 1, 2007) with $200 million threshold, and change in index threshold from $200 to $400 million effective July 1, 2009 (assumed to be announced April 1, 2009).



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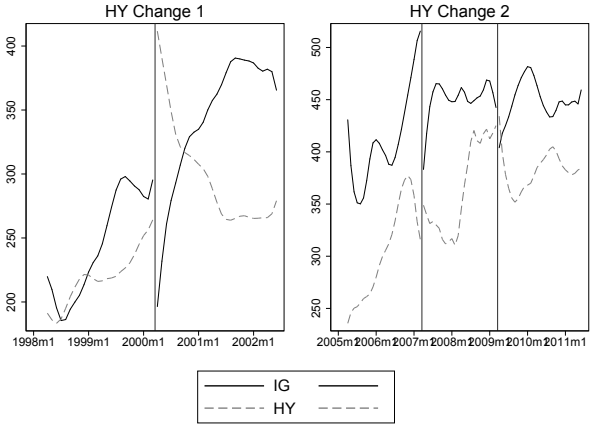

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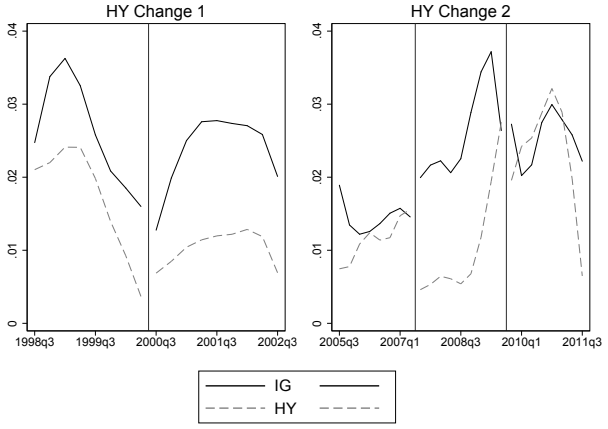

(d)

Fig 11. Graphs of parallel trends in bond sizes (panels (a) and (c)) and propensity to issue (panels (b) and (d)). Panels (a) and (b) examine the four changes in the investment grade index while panels (c) and (d) examine the two changes in the high yield indices (described in detail in Figures 9 and 10). The graphs show the average offering size (in millions) and the average issuance propensity for the two years before and after each change; the vertical lines indicate the timing of the announcement of the change. Data are smoothed using the locally weighted scatterplot smoothing (LOWESS) with a bandwidth of 0.5 for the offering size (monthly data) and a bandwidth of 0.8 for the issuance propensity (quarterly data). Note that the definition of the *post* variable includes only one year before the announcement date and one year after the effective date, excluding any period of time in between the two dates. As such, these graphs are not directly comparable to the difference-in-difference regressions.

Table 1
Descriptive statistics

Panel A: Characteristics of Bond Issuer Sample

	N	Mean	Std. Dev.	Min	p25	Median	p75	Max
Passive demand								
passive_demand_perc	15,397	1.153	1.324	0.000	0.000	0.477	2.261	5.123
passive_demand_bond_perc	15,397	0.461	0.785	0.000	0.000	0.043	0.497	3.192
Bond characteristics								
issue_size (millions)	16,856	429.714	497.739	25.000	150.000	300.000	500.000	15,000.000
log_issue_size	16,856	12.543	0.942	10.127	11.918	12.612	13.122	16.524
spread	16,076	2.698	2.180	0.097	0.939	2.014	4.017	9.663
covenant_score	10,276	0.114	0.074	0.000	0.070	0.092	0.128	0.412
initial_maturity	16,855	11.202	9.150	0.835	6.995	9.988	10.053	100.424
Index thresholds								
threshold_amount (millions)	14,873	206.421	108.380	25.000	100.000	150.000	250.000	400.000
log_threshold_amount	14,873	12.091	0.558	10.127	11.513	11.918	12.429	12.899
Firm characteristics								
avg_rating	14,926	10.272	4.263	1.0	7.0	9.5	14.5	22
inv_grade_dummy	15,397	0.562	0.496	0	0	1	1	1
market_leverage	10,334	0.305	0.203	0.005	0.147	0.258	0.423	0.893
book_leverage	11,706	0.377	0.212	0.002	0.236	0.339	0.478	1.141
log_assets	12,426	8.709	1.676	-2.112	7.588	8.807	9.897	13.543
size	12,628	0.001	0.002	0.000	0.000	0.000	0.001	0.015
age	12,687	11.852	7.969	0.000	5.246	9.999	19.001	27.581
tangibility	12,253	0.396	0.263	0.010	0.168	0.355	0.602	0.918
profitability_op_income	12,133	0.042	0.068	-0.239	0.015	0.045	0.077	0.223
profitability_net_income	12,408	0.010	0.024	-0.108	0.003	0.011	0.020	0.071
q_ratio	10,850	1.096	0.559	0.493	0.714	0.933	1.294	3.530
mktassets_to_bookassets	10,851	1.809	0.895	0.825	1.221	1.553	2.091	5.722
volatility	10,133	0.351	0.182	0.135	0.228	0.302	0.420	1.141
earnings_volatility	12,319	0.014	0.027	0.000	0.002	0.005	0.013	0.187
tax_rate	9,444	0.310	0.893	-2.475	0.000	0.019	0.353	5.051
capex	12,111	0.021	0.027	0.000	0.006	0.013	0.024	0.162
cash	12,415	0.067	0.093	0.000	0.011	0.032	0.083	0.516
depamort	11,737	0.013	0.008	0.001	0.008	0.011	0.016	0.044
selling_expense	10,709	0.195	0.134	0.008	0.093	0.168	0.270	0.676
equity_return	10,359	0.114	0.600	-0.841	-0.162	0.065	0.284	3.864
change_booklev	10,045	0.005	0.050	-0.127	-0.019	0.000	0.020	0.215
rd_to_sales	4,352	0.053	0.070	0.000	0.000	0.029	0.072	0.371
z_score	8,743	1.902	1.531	-1.185	0.898	1.633	2.569	7.985
Macro variables								
y10	16,826	4.44	1.81	1.38	2.65	4.57	5.90	9.09
termslope	16,826	1.24	0.88	-0.49	0.39	1.33	2.00	2.91
baa_aaa_spread	16,826	0.92	0.38	0.50	0.68	0.85	1.04	3.50

Panel B: Characteristics of Full Compustat Sample

	N	Mean	Std. Dev.	Min	p25	Median	p75	Max
Passive demand								
passive_demand_perc	409,764	0.787	1.087	0.000	0.000	0.173	1.249	4.905
Issuer characteristics								
issuer	652,027	0.014	0.118	0	0	0	0	1
avg_offering (millions)	9,201	376.866	361.253	25.000	150.000	273.092	500.000	7,500.000
log_issue_size	9,201	12.499	0.838	10.127	11.918	12.518	13.122	15.830
Firm characteristics								
market_leverage	517,097	0.219	0.249	0.000	0.008	0.125	0.351	0.948
book_leverage	577,266	0.389	0.883	0.000	0.023	0.204	0.415	7.328
log_assets	597,773	4.446	2.734	-6.908	2.751	4.536	6.298	13.649
size	628,611	0.137	0.423	0.000	0.001	0.012	0.068	3.068
age	652,027	7.844	6.635	0.000	2.500	5.999	11.748	27.748
tangibility	595,860	0.259	0.240	0.000	0.070	0.180	0.382	0.919
profitability_op_income	558,906	-0.405	1.804	-14.731	-0.162	0.011	0.064	0.328
profitability_net_income	594,113	-0.107	0.480	-3.871	-0.043	0.003	0.018	0.175
q_ratio	534,851	2.006	3.384	0.392	0.706	1.045	1.846	26.703
mktassets_to_bookassets	532,818	5.033	17.118	0.509	1.118	1.597	2.774	147.880
earnings_volatility	580,112	0.112	0.438	0.000	0.004	0.013	0.044	3.656
tax_rate	465,254	0.136	0.633	-2.439	0.000	0.000	0.131	3.805
capex	556,838	0.016	0.025	0.000	0.003	0.008	0.018	0.158
cash	596,950	0.201	0.250	0.000	0.022	0.088	0.289	0.980
depamort	545,580	0.014	0.013	0.000	0.006	0.011	0.017	0.084
selling_expense	508,339	0.641	1.701	0.020	0.147	0.269	0.476	14.069
equity_return	482,218	1.455	10.055	-0.942	-0.379	-0.033	0.346	90.667
change_booklev	494,719	0.004	0.064	-0.234	-0.013	0.000	0.018	0.248
rd_to_sales	282,214	1.206	5.723	0.000	0.009	0.076	0.214	47.966
z_score	388,925	-2.961	46.285	-374.778	0.374	1.699	3.703	97.522

Table 2
Passive demand, bond size, and credit spread

Regressions of bond characteristics on percentage of bond index value held by passive funds (*passive_demand_perc*). Dependent variable in columns (1)-(4) is *log_issue_size* and in (5)-(8) is *spread*. All regressions include quarter fixed effects and industry fixed effects. Standard errors are clustered at the quarter level. *,**,*** indicate significance at the 10%, 5% and 1% level, respectively.

	Log Offering Size				Spread			
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
passive_demand_perc	0.162***	0.0762**	0.0690**	0.0687**	-0.689***	-0.633***	-0.638***	-0.637***
	(0.0331)	(0.0330)	(0.0323)	(0.0323)	(0.133)	(0.117)	(0.122)	(0.122)
avg_rating	-0.0176***	0.0420***	0.0437***	0.0436***	0.376***	0.268***	0.264***	0.266***
	(0.00475)	(0.00610)	(0.00669)	(0.00670)	(0.00954)	(0.0106)	(0.0130)	(0.0128)
log_assets		0.246***	0.263***	0.263***		-0.130***	-0.126***	-0.124***
		(0.0111)	(0.0130)	(0.0130)		(0.0160)	(0.0188)	(0.0185)
market_leverage		-0.242***	0.0580	0.0593		1.602***	2.457***	2.448***
		(0.0524)	(0.0791)	(0.0792)		(0.148)	(0.173)	(0.173)
age			0.000794	0.000929			-0.00315	-0.00382
			(0.00259)	(0.00261)			(0.00504)	(0.00506)
profitability_net_income			-0.441	-0.414			-4.775***	-4.855***
			(0.458)	(0.458)			(1.226)	(1.222)
tangibility			-0.188***	-0.188***			0.289**	0.285**
			(0.0700)	(0.0700)			(0.120)	(0.119)
mktassets_to_bookassets			0.0429**	0.0433**			-0.0294	-0.0325
			(0.0180)	(0.0179)			(0.0286)	(0.0284)
z_score			0.0453***	0.0451***			0.180***	0.181***
			(0.0126)	(0.0125)			(0.0200)	(0.0202)
earnings_volatility			0.671*	0.674*			2.901***	2.976***
			(0.381)	(0.384)			(0.771)	(0.763)
tax_rate			-0.0356**	-0.0362**			0.0245	0.0270
			(0.0150)	(0.0150)			(0.0226)	(0.0225)
Additional macro controls	No	No	No	Yes	No	No	No	Yes
FISD Industry FE	Yes	No	No	No	Yes	No	No	No
SIC2 Industry FE	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14,926	9,316	6,095	6,093	14,309	8,868	5,778	5,778
R-squared	0.450	0.552	0.584	0.584	0.721	0.746	0.764	0.765
Cluster	Quarter	Quarter	Quarter	Quarter	Quarter	Quarter	Quarter	Quarter

Table 3
Passive demand and other bond characteristics

Regressions of bond characteristics on percentage of bond index value held by passive funds (*passive_demand_perc*). Dependent variable in columns (9)-(12) is *covenant_score* and in (5)-(8) is *initial_maturity*. All regressions include quarter fixed effects and industry fixed effects. Standard errors are clustered at the quarter level. *,**,*** indicate significance at the 10%, 5% and 1% level, respectively.

	Covenant Score				Initial Maturity			
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
passive_demand_perc	-0.00202	-0.00738*	-0.00720	-0.00718	0.951**	0.468	0.820**	0.808**
	(0.00535)	(0.00441)	(0.00560)	(0.00562)	(0.373)	(0.361)	(0.376)	(0.375)
avg_rating	0.00935***	0.00904***	0.0101***	0.0101***	-0.416***	-0.305***	-0.252***	-0.253***
	(0.000827)	(0.000679)	(0.000798)	(0.000798)	(0.0613)	(0.0610)	(0.0599)	(0.0598)
log_assets		-0.00411***	-0.00331***	-0.00332***		0.628***	0.531***	0.530***
		(0.000973)	(0.00114)	(0.00114)		(0.111)	(0.146)	(0.147)
market_leverage		-0.0123*	-0.0123	-0.0122		-0.896	-2.215***	-2.200***
		(0.00721)	(0.0102)	(0.0101)		(0.557)	(0.691)	(0.696)
age			0.000566	0.000572			-0.0173	-0.0167
			(0.000379)	(0.000380)			(0.0200)	(0.0201)
profitability_net_income			-0.0116	-0.00922			1.901	1.862
			(0.0746)	(0.0750)			(4.568)	(4.587)
tangibility			-0.00581	-0.00587			0.564	0.569
			(0.00761)	(0.00762)			(0.892)	(0.894)
mktassets_to_bookassets			-0.00429*	-0.00425*			-0.147	-0.154
			(0.00235)	(0.00234)			(0.165)	(0.167)
z_score			0.00410***	0.00407***			-0.0828	-0.0771
			(0.00141)	(0.00141)			(0.126)	(0.125)
earnings_volatility			-0.0344	-0.0342			-2.164	-2.320
			(0.0532)	(0.0533)			(3.046)	(3.041)
tax_rate			-0.00331***	-0.00336***			-0.0874	-0.0935
Additional macro controls	No	No	No	Yes	No	No	No	Yes
FISD Industry FE	Yes	No	No	No	Yes	No	No	No
SIC2 Industry FE	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	8,891	6,247	4,044	4,044	14,926	9,316	6,095	6,093
R-squared	0.361	0.375	0.406	0.406	0.103	0.116	0.117	0.118
Cluster	Quarter	Quarter	Quarter	Quarter	Quarter	Quarter	Quarter	Quarter

Table 4
The propensity to issue bonds

Regressions of *issuer* dummy on percentage of bond index value held by passive funds (*passive_demand_perc*). All regressions include quarter fixed effects; regressions in columns (1), (3) and (5) include industry fixed effects while regressions in columns (2), (4) and (6) include firm fixed effects. Standard errors are clustered at the quarter and firm level. *,**,*** indicate significance at the 10%, 5% and 1% level, respectively.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
passive_demand_perc	-0.000671	0.00470***	0.00781***	0.00403***	0.00398***	0.00352***
	(0.00194)	(0.00160)	(0.00128)	(0.000875)	(0.00145)	(0.00106)
log_assets	0.00849***	0.00320***	0.0104***	0.00462***		
	(0.000442)	(0.000368)	(0.000525)	(0.000496)		
market_leverage	0.0115***	-0.00409**	0.00607***	-0.00484***		
	(0.00189)	(0.00172)	(0.00192)	(0.00162)		
inv_grade_dummy_est	0.00833***	-0.00131				
	(0.00159)	(0.00110)				
workingcap_to_totalassets			-0.00157***	-0.000465***		
			(0.000159)	(7.98e-05)		
retearnings_to_totalassets			-0.000227***	-8.27e-05***		
			(1.52e-05)	(1.13e-05)		
ebit_to_totalassets			-0.00894***	-0.00159***		
			(0.000613)	(0.000283)		
marketequity_to_totalliab			6.47e-05***	-4.56e-06		
			(1.03e-05)	(6.87e-06)		
sales_to_totalassets			-0.00236	-0.000346		
			(0.00150)	(0.00108)		
size					0.0599***	0.0333***
					(0.00407)	(0.00495)
mktassets_to_bookassets					2.16e-05	-2.70e-05
					(2.22e-05)	(2.49e-05)
capex					0.175***	0.140***
					(0.0257)	(0.0188)
cash					-0.0145***	-0.0137***
					(0.00196)	(0.00192)
depamort					-0.217***	-0.137***
					(0.0350)	(0.0314)
tangibility					0.00785**	0.00203
					(0.00320)	(0.00351)
profitability_net_income					0.000964	-0.000252
					(0.000587)	(0.000496)
earnings_volatility					-0.00257***	4.09e-05
					(0.000576)	(0.000605)
z_score					-1.40e-05	-1.28e-05
					(9.34e-06)	(1.01e-05)
selling_expense					-0.000396***	-9.86e-06
					(0.000106)	(9.49e-05)
selling_expense					-4.25e-05**	-8.85e-06
					(1.70e-05)	(1.90e-05)
equity_return					-0.00504	0.00970*
					(0.00548)	(0.00532)
book_leverage					0.0146***	-0.00280
					(0.00222)	(0.00209)
SIC2 Industry FE	Yes	No	Yes	No	Yes	No
Firm FE	No	Yes	No	Yes	No	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	387,840	387,532	377,701	377,396	272,457	272,081
R-squared	0.045	0.137	0.046	0.133	0.058	0.129
Cluster	Quarter & Firm	Quarter & Firm	Quarter & Firm	Quarter & Firm	Quarter & Firm	Quarter & Firm

Table 5
Passive demand at the bond level

Regressions of bond characteristics on percentage of face value of a given bond purchased by passive funds (*passive_demand_bond_perc*). Dependent variable in columns (1)-(2) is *log_issue_size*, in (3)-(4) is *spread*, in (5)-(6) is *covenant_score*, and in (7)-(8) is *initial_maturity*. All regressions include month fixed effects and firm fixed effects. Standard errors are clustered at the quarter level. *,**,*** indicate significance at the 10%, 5% and 1% level, respectively.

	Log Offering Size		Spread		Covenant Score		Initial Maturity	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
passive_demand_bond_perc	0.339***	0.306***	-0.176***	-0.197***	0.000629	0.000385	-3.055***	-3.650***
	(0.0168)	(0.0232)	(0.0358)	(0.0397)	(0.00142)	(0.00147)	(0.397)	(0.533)
log_assets		0.149***		-0.167***		-0.00547*		0.473
		(0.0239)		(0.0389)		(0.00284)		(0.353)
market_leverage		0.0595		3.016***		-0.0290*		-1.667
		(0.106)		(0.282)		(0.0161)		(1.405)
avg_rating		0.0131		0.273***		0.00718***		-0.158
		(0.00933)		(0.0160)		(0.000851)		(0.112)
age		0.00622		0.0360		-0.00225		-0.00443
		(0.0115)		(0.0287)		(0.00307)		(0.324)
profitability_net_income		0.0590		-2.466**		0.0117		-1.319
		(0.622)		(1.036)		(0.0584)		(7.098)
tangibility		-0.298*		0.712***		-0.0401**		1.317
		(0.159)		(0.234)		(0.0167)		(2.033)
mktassets_to_bookassets		0.000374		-0.0977**		-0.00525**		0.295
		(0.0262)		(0.0397)		(0.00247)		(0.394)
z_score		0.0805***		0.194***		0.00353*		0.0979
		(0.0187)		(0.0305)		(0.00180)		(0.203)
earnings_volatility		1.400***		1.465**		-0.00982		-1.156
		(0.525)		(0.705)		(0.0507)		(4.883)
tax_rate		-0.0142		-0.000208		-0.000484		-0.461**
		(0.0144)		(0.0270)		(0.00140)		(0.202)
Additional macro controls	No	Yes	No	Yes	No	Yes	No	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14,084	5,641	13,428	5,329	8,290	3,680	14,084	5,641
R-squared	0.727	0.757	0.798	0.871	0.720	0.777	0.312	0.297
Cluster	Quarter	Quarter	Quarter	Quarter	Quarter	Quarter	Quarter	Quarter

Table 6
Index threshold changes and issue size

Difference-in-difference regressions of *log_issue_size* around changes in the index threshold. *post_ig* (*post_hy*) takes a value of 0 in the 12 months before an investment grade (high yield) index change is announced and a value of 1 in the 12 months after the change is effective. *treated_ig* (*treated_hy*) takes a value of 1 for investment grade (high yield) issuers and 0 for high yield (investment grade) issuers. Panel A examines the effect across all investment grade index changes (columns (1) and (2)) and across both high yield index (columns (3) and (4)) with change and industry fixed effects. Panel B uses predicted bond sizes and classifies issuers in one of two buckets: predicted amount above the new threshold ('large' bonds - columns (1) and (3)), or predicted amount above the old threshold but below the new threshold ('medium' bonds - columns (2) and (4)). Standard errors are clustered at the change-by-industry or industry level. *,**,*** indicate significance at the 10%, 5% and 1% level, respectively.

Panel A: By Change

VARIABLES	(1)	(2)	(3)	(4)
post_ig	0.0271	-0.00257		
	(0.0431)	(0.0369)		
treated_ig	-0.0103	-0.236***		
	(0.0689)	(0.0713)		
post_ig*treated_ig	0.134*	0.135*		
	(0.0801)	(0.0810)		
post_hy			0.121	0.0942
			(0.0953)	(0.0933)
treated_hy			-0.207**	-0.00434
			(0.0930)	(0.137)
post_hy*treated_hy			0.0433	0.00767
			(0.102)	(0.0948)
log_assets		0.198***		0.196***
		(0.0270)		(0.0277)
avg_rating		0.0247**		0.0245
		(0.0122)		(0.0240)
Change FE	Yes	Yes	Yes	Yes
SIC2 FE	Yes	Yes	Yes	Yes
Observations	2,659	2,598	1,521	1,484
R-squared	0.351	0.418	0.228	0.302
Cluster	ChangexSIC2	ChangexSIC2	ChangexSIC2	ChangexSIC2
Sample	All IG Changes	All IG Changes	All HY Changes	All HY Changes

Panel B: By Issuer Bucket

VARIABLES	(1)	(2)	(3)	(4)
post_ig	0.0368	0.129		
	(0.0355)	(0.167)		
treated_ig	0.00488	-0.530**		
	(0.0730)	(0.204)		
post_ig*treated_ig	0.112	0.634***		
	(0.0884)	(0.194)		
post_hy			0.0477	0.634***
			(0.114)	(0.213)
treated_hy			-0.241**	-0.506***
			(0.101)	(0.176)
post_hy*treated_hy			0.213**	0.523*
			(0.102)	(0.259)
Change FE	Yes	Yes	Yes	Yes
SIC2 FE	Yes	Yes	Yes	Yes
Observations	2,327	216	1,221	206
R-squared	0.340	0.510	0.200	0.447
Cluster	SIC2	SIC2	SIC2	SIC2
Bucket	Large	Medium	Large	Medium

Table 7
Index threshold changes and bond issuance

Difference-in-difference regressions of *issuer* dummy around changes in the index threshold. *post_ig* (*post_hy*) takes a value of 0 in the 12 months before an investment grade (high yield) index change is announced and a value of 1 in the 12 months after the change is effective. *treated_ig* (*treated_hy*) takes a value of 1 for investment grade (high yield) issuers and 0 for high yield (investment grade) issuers. Standard errors are clustered at the firm level. *,**,*** indicate significance at the 10%, 5% and 1% level, respectively.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
post_ig	-0.00983***	-0.00885***	-0.00770***			
	(0.00105)	(0.00104)	(0.00116)			
treated_ig	0.0115***	0.00920***	0.00497***			
	(0.00204)	(0.00175)	(0.00192)			
post_ig*treated_ig	-0.00359*	-0.00272	-0.00372*			
	(0.00190)	(0.00182)	(0.00204)			
post_hy				0.00684***	0.00577***	0.00505***
				(0.00154)	(0.00150)	(0.00189)
treated_hy				-0.00653***	-0.00524***	-0.00182
				(0.00165)	(0.00151)	(0.00167)
post_hy*treated_hy				-0.00230	-0.00156	0.000339
				(0.00196)	(0.00192)	(0.00234)
log_assets		0.00866***			0.00738***	
		(0.000407)			(0.000375)	
market_leverage		0.0106***			0.00702***	
		(0.00201)			(0.00224)	
size			0.0575***			0.0563***
			(0.00466)			(0.00458)
mktassets_to_bookassets			7.80e-06			-3.10e-07
			(4.06e-05)			(3.49e-05)
capex			0.116***			0.0406
			(0.0304)			(0.0307)
cash			-0.0129***			-0.0115***
			(0.00236)			(0.00274)
depamort			-0.218***			-0.0859*
			(0.0396)			(0.0453)
tangibility			0.00797**			0.0105**
			(0.00383)			(0.00456)
profitability_net_income			0.00139			0.000401
			(0.00159)			(0.00117)
earnings_volatility			-0.00161			-0.00190**
			(0.00155)			(0.000916)
z_score			-3.66e-05*			-9.46e-06
			(2.22e-05)			(1.16e-05)
selling_expense			-0.000136			-0.000249**
			(0.000203)			(0.000108)
selling_expense			-3.08e-05			1.67e-06
			(3.73e-05)			(4.71e-05)
equity_return			0.000982			-0.0101
			(0.00704)			(0.00757)
book_leverage			0.0142***			0.0114***
			(0.00257)			(0.00277)
Change FE	Yes	Yes	Yes	Yes	Yes	Yes
SIC2 FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	105,533	99,316	68,942	61,779	57,951	41,634
R-squared	0.020	0.044	0.056	0.013	0.037	0.055
Cluster	Firm	Firm	Firm	Firm	Firm	Firm
Sample	All IG changes	All IG changes	All IG changes	All HY changes	All HY changes	All HY changes

Appendix A. Variable definitions

Dependent variables

log_issue_size	Log of the total bond face value.	FISD
spread	Offering yield (or coupon directly if offering yield is not available) minus the applicable risk-free rate. The applicable risk-free rate is linearly interpolated between Treasury bonds (using the 1, 2, 3, 5, 7, 10, 20 and 30 year bonds as available) based on the bond's initial time to maturity. For bonds with an initial maturity less than one year or greater than the longest available government bond, we take the risk-free rate as the yield on the 1-year Treasury or on the longest Treasury bond, respectively. Negative spreads are removed. Winsorized at the 1% and 99% levels.	Offering yield: FISD; risk-free rate: Federal Reserve Bank of St. Louis
covenant_score	$cov\_score = 0.25 * RP + 0.1 * RI + 0.25 * DEBT + 0.2 * LIEN + 0.1 * SS + 0.1 * COC$, where where RP stands for Restricted Payments, RI stands for Risky Investments, DEBT represents Debt Incurrence, LIEN represents Liens Subordination, SS stands for Structural Subordination and COC stands for Change of Control. Covenants are classified into each bucket and the bond receives a category score equal to the number of covenants included divided by the total number of covenants in the category. Examples of each category: "restricted payments" for RP, "investments" for RI, "indebtedness" for DEBT, "negative pledge covenant" for LIEN, "fixed charge coverage" for SS, and "change control put provisions" for COC.	Formula: adapted from Moody's Covenant Quality Index; covenants: FISD
initial_maturity	Maturity date minus offering date, divided by 365.25.	FISD
issuer	Dummy that takes on a value of 1 if the firm issued a bond in the following financial quarter.	FISD
market_leverage	Total debt divided by total debt plus market value of common equity, measured as of the most recent quarter before the offering date. Winsorized at the 1% and 99% levels.	Compustat
book_leverage	Total debt divided by book value of assets, measured as of the most recent quarter before the offering date. Winsorized at the 1% and 99% levels.	Compustat

Independent variables

Variable	**Definition**	**Source**
passive_demand_perc	Total value of net assets invested in passive corporate bonds divided by total face value of bonds eligible to be included in the index. Separated by investment grade (uses Bloomberg Barclays U.S. Corporate Index) and high yield (uses Bloomberg U.S. Corporate High Yield Index).	CRSP Survivor-Bias-Free U.S. Mutual Fund database (total net assets) and FISD (face value of index)
passive_demand_bond_perc	Percentage of face value of a bond purchased by passive funds. Sum across all passive funds of the product of (i) a dummy for inclusion in an index at the time of bond issuance and (ii) the fund's total net assets divided by index face value at the time of bond issuance. Winsorized at the 1% and 99% level.	Index rules (dummy for inclusion), CRSP Survivor-Bias-Free U.S. Mutual Fund database (total net assets) and FISD (face value of index)
logthresh	Log of the rating-appropriate index threshold.	Bloomberg (IG) and iBoxx (HY)
post_ig	Dummy that takes on a value of 0 for the period 15 months to 3 months before an investment grade index threshold change and a value of 1 for the 12 months after the change.	Bloomberg IG index
post_hy	Dummy that takes on a value of 0 for the period 15 months to 3 months before a high yield index threshold change and a value of 1 for the 12 months after the change.	Bloomberg and iBoxx HY indices

treated_ig & treated_hy	Dummy that takes on a value of 1 for investment grade (high yield) bonds with respect to investment grade (high yield) index changes, and 0 for high yield (investment grade) bonds.	Bloomberg and iBoxx

Controls

avg_rating	Simple average of the initial ratings assigned to the bond by Moody's, Fitch and Standard & Poor's (converted to a common inverted numerical scale, i.e. AAA bonds receive a rating of 1, bonds in default receive a rating of 22). If a particular bond does not have an initial rating that meets this criterion, the initial rating is assumed to be the same as the issuer's most recent rating.	FISD
inv_grade_dummy	Dummy that takes on a value of 1 if the *avgrating* is less than or equal to 10 (corresponds to BBB-/Baa3).	FISD
inv_grade_dummy_est	Dummy that takes on a value of 1 if the firm is estimated to be investment grade and 0 otherwise. Investment grade estimation is done by regressing investment grade status for rated firms on $wc2ta$, $re2ta$, $ebit2ta$, $me2tl$ and $s2ta$, predicting the value for all firms and assigning a cutoff value that correctly classifies the highest percentage of rated observations.	Compustat and FISD
log_assets	Log of the firm's total assets.	Compustat
size	Sales divided by the total sales of all firms in a quarter (variable multiplied by 1000). Winsorized at the 1% and 99% levels.	Compustat
market_leverage	See above.	Compustat
volatility	Trailing 250 day stock price volatility. Winsorized at the 1% and 99% levels.	CRSP
profitability_op_income	Trailing twelve month income before extraordinary items divided by total assets. Winsorized at the 1% and 99% levels.	Compustat
tangibility	Net property, plant and equipment divided by total assets. Winsorized at the 1% and 99% levels.	Compustat
q_ratio	Total market value of common equity plus book value of liabilities divided by book value of assets and liabilities.	Compustat
tax	Trailing twelve month taxes payable dividend trailing twelve month pre-tax income, measured as of the most recent quarter before the offering date. Winsorized at the 1% and 99% levels.	Compustat
age	Financial reporting date minus first recorded reporting date, divided by 365.25.	Compustat
mktassets_to_bookassets	Book value of assets minus book value of equity plus market value of equity, divided by book value of assets. Winsorized at the 1% and 99% levels.	Compustat
profitability_net_income	Quarterly net income divided by total assets. Winsorized at the 1% and 99% levels.	Compustat
earnings_volatility	Absolute change in quarterly net income, divided by total assets. Winsorized at the 1% and 99% levels.	Compustat
cash	Cash and short-term investments divided by total assets. Winsorized at the 1% and 99% levels.	Compustat
depamort	Depreciation and amortization divided by total assets. Winsorized at the 1% and 99% levels.	Compustat
equity_return	Cumulative four quarter stock price return. Winsorized at the 1% and 99% levels.	Compustat
change_booklev	Change in quarterly *book_leverage*. Winsorized at the 1% and 99% levels.	Compustat
z_score	$z\_score = 1.2 * wc2ta + 1.4 * re2ta + 3.3 * ebit2ta + 0.6 * me2tl + 0.999 * s2ta$. Calcualted using raw values; result winsorized at the 1% and 99% levels.	Compustat
workingcap_to_totalassets	Current assets less current liability, divided by total assets. When used as a direct variable, winsorized at the 1% and 99% levels.	Compustat

retearn_to_totalassets	Retained earnings divided by total assets. When used as a direct variable, winsorized at the 1% and 99% levels.	Compustat
ebit_to_totalassets	EBITDA minus depreciation and amortization, divided by total assets. When used as a direct variable, winsorized at the 1% and 99% levels.	Compustat
marketequity_to_totalliab	Market value of equity divided by liabilities. When used as a direct variable, winsorized at the 1% and 99% levels.	Compustat
sales_to_totalassets	Sales divided by total assets. When used as a direct variable, winsorized at the 1% and 99% levels.	Compustat
rd_to_sales	Research and development expenses divided by sales. Winsorized at the 1% and 99% levels.	Compustat
selling_expense	Selling, general and administrative expenses divided by total assets. Winsorized at the 1% and 99% levels.	Compustat
y10	10-year Treasury bond rate.	Federal Reserve Bank of St. Louis
termslope	10-year Treasury bond rate minus 2-year Treasury bond rate.	Federal Reserve Bank of St. Louis
baa_aaa_spread	Moody's seasoned Baa corporate bond yield minus Moody's seasoned Aaa corporate bond yield.	Federal Reserve Bank of St. Louis

Appendix B. Tracked Bond Indices

Investment grade bond indices

Given its dominance in the investment grade index market, we focus exclusively on the Bloomberg indices (formerly administered by Barclays and Lehman Brothers) for investment grade bonds.

The single index with the largest passive bond following is the Bloomberg Barclays U.S. Aggregate Index, the flagship benchmark index that measures the investment grade, U.S. dollar-denominated, fixed-rate taxable bond market. It is comprised of the constituents of the U.S. Treasury Index, the U.S. MBS Index, the U.S. CMBS Index, and the U.S. Credit Index (comprised of the corporate bonds and government-related bonds, such as agencies, sovereigns, supranationals and local authorities). The pure corporate bond index is the Bloomberg Barclays U.S. Corporate Index. The indices are value weighted and rebalanced/reconstituted on a monthly basis. Though it varies over time, corporate bonds make up approximately 20% of the Aggregate Index.

The investment grade indices have had changes in index inclusion rules, including changes to minimum size (face value) for inclusion, changes to bond types that are includable, and changes to the calculation of ratings. The minimum face value to be included in the index evolved as follows[21]:

- Until August 1, 1988: $1 million
- Between August 1, 1988 and January 1, 1992: $25 million
- Between January 1, 1992 and January 1, 1994: $50 million
- Between January 1, 1994 and July 1, 1999: $100 million
- Between July 1, 1999 and October 1, 2003: $150 million (announced February 24, 1999)
- Between October 1, 2003 and July 1, 2004: $200 million (announced June 17, 2003)
- Between July 1, 2004 and April 1, 2017: $250 million (announced March 18, 2004)
- Since April 1, 2017: $300 million (announced January 24, 2017)

In terms of includable bonds, the following bond types became eligible for inclusion: covered bonds on January 1, 2011; fixed-to-floating perpetual bonds without a coupon step-up on the first call date on January 1, 2008; and 144A bonds with registration rights on July 1, 2000. In terms of rating methodology, until October 1, 2003, Moody's was the only rating considered, with S&P if Moody's not available. From October 1, 2003 to July 1, 2005, the lower of Moody's and S&P was considered the rating. Finally, since

[21] For our analysis with index inclusion eligibility, we use announced dates where found; otherwise, we assume the change was announced three months prior to the effective date.

July 1, 2005, the middle rating of Moody's, S&P and Fitch is considered the rating (if only two are available, the lower of the two is taken).

High yield indices

There are two dominant players in the high yield index space - Markit iBoxx and Bloomberg. The Markit iBoxx Liquid High Yield Index measures the high yield, U.S. dollar-denominated, fixed rate corporate bond market. Though the index was adapted from the Goldman Sachs $HYTop Index which was established on December 31, 1998, the first fund following the iBoxx HY index was only established in March 2007; for this reason, we consider the impact of this index on bonds issued in or after April 2007.

The iBoxx HY index went through a complete overhaul of rules in June 2009, moving from including only the 50 largest eligible bonds to including all eligible bonds (it also moved from equal weighting to market value weighted and moved from best rating to average rating for determination of high yield status). At the time of this index overhaul, it also revised the minimum face value for inclusion:

- Until July 1, 2009: $200 million
- Since July 1, 2009: $400 million (and issuer must have at least $1 billion total face value)

In April 2012, the index removed the requirement that an eligible bond must be less than 5 years old and reduced the required time until maturity to one year from three, among other changes.

Because of the drastic change in the Markit iBoxx Liquid High Yield Index in April 2009, we also look at the Bloomberg Barclays U.S. Corporate High Yield Index, which we use to calculate the total face value of eligible HY bonds (used as the denominator in our $passive\_demand\_perc$ variable). This index tracks the high yield, U.S. dollar-denominated, fixed-rate corporate bond market; it is value weighted and rebalanced monthly. The index increased the threshold for inclusion from $100 million to $150 million in July 2000 (the only change in index threshold). Though there was no direct passive investment in high yield bonds at the time of the change, we include this change as we believe there were active funds using this index as a benchmark.