On the Nature and Predictability of Corporate Bond Returns[a,b]

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On the Nature and Predictability of Corporate Bond Returns

Abstract

Corporate bond returns consist of two distinct components: an interest rate component, which is default-free and anti-cyclical, and a credit spread component, which is default-risky and pro-cyclical. These components are mutually negatively correlated and their relative importance varies with credit quality. We show that it is of critical importance to take this into account when studying the predictability of corporate bond returns. In this paper we focus on the credit spread component of corporate bond returns, enabling us to find new predictors that were previously unknown to the literature. Moreover, by re-examining previously documented predictors, we are able to dismiss several of them as irrelevant for credit spread returns and to explain inconsistent findings between investment grade and high yield corporate bonds. In total, we find four factors with significant in-sample and out-of-sample predictability of both investment grade and high yield excess returns over Treasury. Two variables come from the existing literature: past equity return and past corporate bond return. Evidence for the other two variables is new: change in implied equity volatility and the Halloween indicator.

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1 Introduction

Even though it is well-documented that corporate bond returns are driven by both interest rate and credit spread variations, the vast majority of the corporate bond predictability literature does not separate these two components. This is an important omission, because the nature of the two return components is very different: the interest rate component is default-free and anti-cyclical, whereas the credit spread component is default-risky and pro-cyclical (see for example Ilmanen (2010)). The differences in nature of the two return components imply that they are likely to be driven by different factors or that factors that are positively related to one return component are negatively correlated to the other. Furthermore, depending on the credit quality of the company, either the interest rate or the credit spread component will be the dominant source of return variations. Since investment grade corporate bond returns are primarily driven by interest rate variations and to a lesser extent by credit spread variations, previous studies on corporate bond predictability (starting with Keim and Stambaugh (1986) and Fama and French (1989)) primarily found predictors of interest rate returns when analyzing investment grade bonds. Furthermore, previous studies often found inconsistent results between investment grade and high yield corporate bonds, because unlike for investment grade, for high yield the credit spread component is the dominant driver of return variations.

The key contribution of our study is that we aim to predict excess returns over duration-matched Treasury bonds, thus removing the interest rate component and explicitly focusing on the credit spread component. This enables us to test new variables that are especially relevant for predicting credit spread variations (such as illiquidity, equity volatility and company fundamentals) and variables that are likely to have different predictive signs for the two return components (such as variables related to risk aversion). As far as we know, these variables have not been tested before in the existing literature on corporate bond predictability. Our study documents the predictive power of three new variables over our 1988-2010 sample period: the change in VIX (a proxy for asset volatility as motivated by the Merton (1974) model), the TED spread (a proxy for corporate bond illiquidity) and the Halloween indicator ("sell in May and go away, but remember to come back in November" of Bouman and Jacobsen (2002), which is often seen as a proxy for risk aversion).

The existing academic literature did document other predictors of corporate bond returns, but most of these studies investigated returns over the risk-free rate, which still includes an interest rate component. Early work by Keim and Stambaugh (1986) found the past equity return to be a significant predictor of investment grade returns, but not of high yield returns. Fama and French (1989), Fuller and Kling (1994) and Sangvinatsos (2005) documented predictability using the dividend yield, the term premium and the default premium, but the latter only worked for investment grade. Maxwell (1998) studied the January Effect and found that its predictive power increased as the bond rating declined.

In our study, we retest all previously documented predictors of corporate bond returns to see whether they not only predict the sum of the interest rate and credit spread components, but also the credit spread component by itself. We conclude that past equity returns and the January Effect positively predict the credit spread component of corporate bond returns, but have negative impact on the interest rate component. Furthermore, the default premium only predicts the interest rate component and has no predictive power for the credit spread component. These findings explain why previous studies found inconsistent results between investment grade and high yield for these variables.

To the best of our knowledge, Clinebell et al. (1996) is the only study in the existing literature that analyzed predictability of excess returns over Treasury bonds, hence analyzing the credit spread component, just like this paper. Although they seemed more concerned with time series properties than with predictability, their AR(1) term can be interpreted as last month's return predicting next month's return. In our study, we confirm the predictive power of this variable for the credit spread component by itself, as well as for the sum of the interest rate and credit spread components.

A related strand of literature aims to find market-timing variables for the decision whether to invest in corporate bonds or in Treasury bonds, see for example Fridson and Bersh (1994), Boyd and Mercer (2010) and Van Luu and Yu (2011). Although these studies used excess returns of corporate bonds over Treasury bonds, they did not make sure that the durations of the Treasury bonds and the corporate bonds were properly matched, so that their return differential may still be driven by interest rate variations.[1] Furthermore, these studies analyzed only one predictor variable, whereas we take a comprehensive approach by testing all previously documented and several new variables. Finally, these studies lacked the statistical rigor of in-sample and out-of-sample tests. In contrast, we follow the latest literature on the predictability of equity returns (see for instance Campbell and Thompson (2008) and Goyal and Welch (2008)), by running expanding window predictive regressions and comparing the out-of-sample return forecasts to those of the historical mean model using the Clark and West (2007) statistic.

On aggregate, we find seven variables that show in-sample and out-of-sample significant predictability for either investment grade or high yield corporate bonds, or both: past equity return, past corporate bond return, change in implied equity volatility, Halloween indicator, TED spread, term premium and January Effect. However, only the first five are significant for both investment grade and high yield. Moreover, TED spread does not pass all our robustness analyses, where we check for stability of the predictability through time, on the underlying rating indexes and on liquid sub-indexes. In sum, our results strongly imply that corporate bond markets are predictable using four variables: past equity return, past corporate bond return, change in implied equity volatility and the Halloween indicator.

[1] For their analyses starting in 1988, Van Luu and Yu (2011) do use duration-matched excess returns.

The remainder of this paper is structured as follows. In Section 2 we elaborate on the differences in nature between the interest rate and credit spread components of corporate bond returns. We conduct a variance decomposition to show that the majority of the variation in investment grade corporate bond returns is driven by interest rate variations and the majority of high yield return variations by changes in credit spreads. In Section 3 we describe our predictor variables: known variables from the existing corporate bond predictability literature and new variables motivated by theoretical credit risk models or explanatory empirical studies. Section 4 contains a description of our methodological framework. Section 5 documents our empirical results, including our main findings on the differences in predictability of the stand-alone credit spread component vs. predictability of the sum of the interest rate and spread components. Section 6 concludes.

2 Excess Returns

2.1 Data Sources

We use two corporate bond indexes from Barclays Capital: the US Corporate Investment Grade (IG) Index and the US Corporate High Yield (HY) Index[2]. These indexes are commonly used in academic studies and by practitioners as benchmarks for managing corporate bond portfolios. Hence, they provide a useful representation of the corporate bond market. For both indexes, we download total returns, excess returns, durations and credit spreads. Excess returns and credit spreads are calculated over duration-matched Treasury bonds, so that both are properly cleansed from interest rate influences.

[2] Formerly maintained by Lehman Brothers.

We use 22 years of monthly data over the period from August 1988 to July 2010.[3] This period covers several business cycles and events, including the recessions that ended in 1991, 2001 and 2009, the Asian crisis in 1997, the default of Russia and the collapse of the Long Term Capital Management hedge fund in 1998 and the sub-prime crisis of 2007-2008.

Over the same period, we download total returns of 1-month Treasury Bills from Kenneth French's website.[4] These are used to calculate the excess return of a corporate bond over the risk-free rate as its total return minus the 1-month Treasury Bill return.

2.2 The Nature of Corporate Bond Returns

Before we study the predictability of corporate bond returns, we should first understand the nature of corporate bonds returns. According to the Merton (1974) framework, a corporate bond can be decomposed into a default-free bond and a default-risky component. So, the excess return $ER_{C,f}$ of a corporate bond over the risk-free rate can be written as

$$ER_{C,f} = ER_{T,f} + ER_{C,T} \tag{1}$$

where $ER_{T,f}$ is the excess return of a Treasury bond (that matches the corporate bond's duration) over the risk-free return and $ER_{C,T}$ is the excess return of the corporate bond over the Treasury bond. Hence, the excess return of a corporate bond over the risk-free rate contains two components: a default-free part $ER_{T,f}$ and a default-risky part $ER_{C,T}$. The nature of the two components is very different. The first component, $ER_{T,f}$, can be recognized as the term premium, which is the compensation for taking interest rate risk. This part is driven by changes in Treasury yields. The nature of this component is anti-cyclical (see for example Ludvigson and Ng (2009)): excess Treasury bond returns tend to be positive when the economy heads into a recession and

[3] The starting date of August 1988 coincides with the availability of duration-matched excess returns.

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

economic growth is low or negative; they are negative in expansions, when the economy is growing and inflation is emerging.

The second component of corporate bond returns, $ER_{C,T}$, can be interpreted as the default premium, which is the compensation for exposure to default risk. This part is driven by changes in credit spreads. Contrary to the first component, this second component is pro-cyclical: it correlates positively to growth. Van Luu and Yu (2011) documented positive excess returns of BBB-rated corporate bonds over Treasury bonds during recoveries and expansions and negative excess returns during slowdowns and recessions.

Ilmanen (2010, Chapter 16) also discussed the differences in nature between the two components of corporate bond excess returns. His Table 16.1 shows a –23% correlation of $ER_{T,f}$ with changes in the consensus growth forecast over the period from 1990 to 2009, compared to a +42% correlation of $ER_{C,T}$. This also implies that the two components are mutually negatively correlated. For our sample, from 1988 to 2010, this is confirmed: we find that the correlation between $ER_{T,f}$ and $ER_{C,T}$ equals –28% for IG and –44% for HY.

Depending on the relative importance of the default-free component and the default-risky component, corporate bond returns will be predominantly driven by changes in interest rates or by changes in credit spreads. For high-quality firms (say investment grade), default is relatively remote; we therefore expect that $ER_{C,T}$ is relatively unimportant and that $ER_{T,f}$ will be the dominant driver of returns. On the other hand, for low-quality firms (say high yield) $ER_{C,T}$ is expected to be more dominant than $ER_{T,f}$.

These implications have been found in empirical studies on corporate bonds, including early work by Keim and Stambaugh (1986) and more recent work by Sangvinatsos (2005) and Schaefer and Strebulaev (2008). Perhaps the most well-known evidence is the Fama and French (1989) two-factor model for corporate bond returns: the *TERM* factor measures interest rate risk and the *DEFAULT* factor measures default risk. In their work, they found larger and more significant

TERM coefficients for higher rated bonds and larger and more significant *DEFAULT* coefficients for lower rated bonds. Similar results are found in the hedging literature. For example, early work by Grieves (1985) and Landes, Stoffels and Seifert (1985), and recent work by Ambastha et al. (2010) showed that the hedge ratio of corporate bonds to Treasury bonds decreases as the credit quality goes down. Furthermore, Grieves (1985) showed that lower graded corporate bonds have larger hedge ratios to equity futures contracts, which can be seen as a proxy for credit risk.

To substantiate our claim that investment grade corporate bond excess returns over the risk-free rate are mainly driven by interest rate variations and to a lesser extent by credit spread variations, we conduct a variance decomposition on Equation (1); see Appendix A for a description of the methodology. Table 1 shows the results as applied to the Barclays Capital IG and HY indexes. The first row shows that for IG corporate bonds the majority of the return variation comes from the interest rate component: 67%. For HY corporate bonds, the biggest driver of return variability is credit spread variation, explaining 95% of the variance. In the second row we show the outcomes of the variance decomposition when we leave out the last three years of our sample.[5] The figures show that without the last three years the interest rate component is more important for both IG and HY. For IG, interest rate variations now explain 95% of the variance, leaving only 5% for credit spread variability. For HY, the interest rate component increases to 19%, but this is still substantially less than the 81% taken by the credit spread component. We conclude that IG returns are mainly driven by the interest rate component and HY returns by the credit spread component.

[5] The reason to omit these years is that several returns in this period are either strongly negative (in the months following Lehman Brothers' default in September 2008) or strongly positive (when the markets recovered in the first months of 2009). These extreme returns, caused by extreme credit spread movements, strongly influence the outcomes of the analysis.

[insert Table 1 around here]

2.3 Which Excess Return Should be Predicted?

Now that we have more insight in the nature of corporate bond excess returns, we can address the question which type of excess return should be predicted: the excess return over the risk-free rate, $ER_{C,f}$, or the excess return over a duration-matched Treasury bond, $ER_{C,T}$? Most previous studies on corporate bond predictability aimed to predict the excess return over the risk-free rate. From the above discussion it follows that instead of finding factors that predict default risk, the empirical results from these studies pointed to factors that also, or even primarily for IG bonds, predict interest rate risk.

The key contribution of our study is that we try to find predictors of the excess return over Treasury, $ER_{C,T}$, which is only driven by changes in credit spreads. Therefore, our empirical results yield conclusions on the predictability of credit spread returns, unlike many previous studies that, especially for high-grade corporate bonds, mostly found predictors of interest rate returns. By analyzing excess returns over Treasury, we are able to obtain consistent results for IG and HY, because for both only credit spread variations matter. In contrast, previous studies using excess returns over the risk-free rate sometimes found inconsistent results between IG and HY, because the former is predominantly driven by anti-cyclical factors and the latter by pro-cyclical factors. In Section 5 we discuss our results in more detail and compare them to findings from previous literature.

To the best of our knowledge, there are only a few studies that analyzed predictability of excess returns over Treasury bonds. Clinebell et al. (1996) investigated an AR(1) model, which can be interpreted as last month's return predicting next month's return. The other studies come from the literature on 'market timing tools': depending on whether a 'timing variable' is relatively high or low, a position is taken in corporate bonds or Treasury bonds. Fridson and Bersh (1994) tested the yield differential between high yield bonds and Treasury bonds, Boyd and Mercer (2010) tested turning points in the FED discount rate cycle and Van Luu and Yu (2011) tested an aggregate indicator of economic activity.

Unlike our study, none of these studies formally tested the significance of their variables using in-sample and out-of-sample statistical tests, as has become standard in the predictability literature. Moreover, these studies tested only one variable, whereas we evaluate the predictive ability of multiple variables. Finally, these studies, except Van Luu and Yu (2011), just subtracted government bond returns from corporate bond returns, without verifying whether the two series have matching durations. This is important in order to properly cleanse the corporate bond total returns from interest rate returns.

2.4 Summary Statistics

Descriptive statistics of both types of excess returns of the IG and HY indexes are presented in Table 2. We observe that the mean excess return over the risk-free rate is larger than the mean excess return over Treasury. This is the result of generally falling Treasury yields over the sample period.

[insert Table 2 around here]

3 Predictor Variables

We test the predictability of corporate bond excess returns using a variety of predictor variables. We split them into two groups. The first group contains variables that are known from the existing corporate bond predictability literature. The second group consists of variables from other strands of literature and were not yet tested on corporate bonds. Given our interest in predicting the pro-cyclical component of corporate bonds returns, the variables in this latter group have been chosen to represent spread-related themes, like default risk and liquidity risk.

3.1 Variables from Predictive Corporate Bond Literature

The first group of predictors contains variables for which previous academic literature documented predictability of corporate bond returns. However, as mentioned before, for virtually all of the variables, predictability has been shown for excess returns *over the risk-free rate*. Therefore, for this group of variables we are particularly interested in the differences between predictability of excess returns over the risk-free rate on the one hand and over Treasury on the other hand. In particular, we expect to find differences between IG and HY, because for IG excess returns over the risk-free rate are mainly driven by anti-cyclical factors, while for HY pro-cyclical factors are more dominant.

Equity Market Return (*EQ*)[6]

The equity market return can be seen as a proxy for changes in the overall business climate and is thus an example of a pro-cyclical variable. We therefore expect the default-free component of corporate bond returns to respond negatively to positive equity returns. Ilmanen (1995) confirmed this in his predictability study of Treasury bond returns. On the other hand, we expect the default-risky component to respond positively to equity market returns. This is confirmed by studies on the predictability of credit default swap index returns by Fung et al. (2008) and Ehlers et

[6] Between parentheses we introduce the abbreviation that will be used later in the discussion of the results.

al. (2010). Given these findings, either a negative, positive or insignificant predictive relationship may be found of equity returns on excess returns of corporate bonds over the risk-free rate, depending on the relative importance of both components.

There is little empirical research on the predictive relationship between equity market returns and corporate bond index returns. As far as we know, the only paper that studied this relationship is Keim and Stambaugh (1986).[7] They found mixed results in predicting corporate bond excess returns *over the risk-free rate* with S&P index returns. For example, in-sample regressions on a 1928-1952 sample yielded insignificant results for high-grade investment grade bonds (AAA/AA), but significant results for BBB-rated and HY bonds. This is consistent with our expectations, because high-quality corporate bonds have only a small pro-cyclical component, while lower-quality credits are more driven by pro-cyclical variations.

We define *EQ* as the 1-month excess return over the risk-free rate. Our equity data are from Kenneth French' website.

Term Premium (*TERM*)

The term premium, which is the slope of the term structure of interest rates, is a well-documented indicator of future economic growth, see for instance Stock and Watson (1989) and Estrella and Hardouvelis (1991). Several studies have addressed the predictive power of the term premium for corporate bond excess returns *over the risk-free rate*. For example, Fama and French (1989) showed that the term premium can predict IG and HY bond excess returns, both in-sample and

[7] On an individual company level, there is more evidence of a spill-over effect from stocks to bonds from the same company, see for example Kwan (1996) and Gebhardt et al. (2005). Finally, the equity market return is often used in explanatory studies of credit spread changes, such as Collin-Dufresne et al. (2001), Elton et al. (2001) and Avramov et al. (2007) and in studies on hedging corporate bonds with equities, such as Schaefer and Strebulaev (2008).

out-of-sample. Fuller and Kling (1994) and Sangvinatsos (2005), however, found that out-of-sample predictability disappears for HY bonds. This is another example of inconsistent results between IG and HY when predicting excess returns over the risk-free rate.

In our study, we define *TERM* as the 10-year US Treasury yield minus the 2-year US Treasury yield. Data are obtained from Bloomberg.

Default Premium (*DEFAULT*)

Just like the term premium, the default premium, which is the difference between high grade and lower grade corporate bond yields, is also related to the business cycle. Fama and French (1989) argued that, whereas the term premium is more related to short-term variations, the default premium captures longer-term movements in economic activity. The default premium has been subject of various studies. Fama and French (1989) documented that the default premium can predict IG and HY excess returns *over the risk-free rate*, both in-sample and out-of-sample. Again, Fuller and Kling (1994) and Sangvinatsos (2005) found that out-of-sample predictability is only present for IG and not for HY. Using excess returns *over Treasury bonds*, Fridson and Bersh (1994) also found little support for the default premium as a useful market-timing indicator in the high yield bond market. These results suggest that the default premium only predicts the anti-cyclical component of corporate bond returns and not the pro-cyclical component.

We define *DEFAULT* as the difference between the option-adjusted credit spread on the Barclays Capital US BBB and AAA corporate bond indexes.

Dividend Yield (*DIVYIELD*)

Next to the term and default premiums, Fama and French (1989) also introduced the dividend yield to the corporate bond predictability literature. They linked this variable to long-term variations in the business cycle, just like the default premium. Fama and French (1989) found that dividend yield is a significant predictor of corporate bond excess returns *over the risk-free rate*. Before Fama and French' study, dividend yield was already documented as a predictor of equity returns, starting with Ball (1978).

We define *DIVYIELD* as the annual dividend per share divided by the price per share. For consistency with the dividend payout and leverage variables (to be introduced later), we calculate the dividend yield as the equally weighted average over the constituents of the FTSE World Country Index USA. Data are obtained from Compustat and Worldscope.

Dividend Payout (*DIVPAY*)

In the academic literature, dividend payout is frequently used as a proxy for profitability, which is an indicator of a firm's ability to meet its obligations. Lamont (1998) showed that dividend payout has forecasting power for excess returns of corporate bonds and stocks *over the risk-free rate*. Further, he argued that dividend payout is related to current business conditions.

We define *DIVPAY* as the annual dividend per share divided by the earnings per share. We calculate the equally weighted average of this ratio over the constituents of the FTSE World Country Index USA. Data are obtained from Compustat and Worldscope.

January Effect (JANUARY)

In January, risky assets tend to perform well and risk-free assets poorly. This "January Effect" has been documented for stocks by Keim (1983), for government bonds by Clayton et al. (1989), and for corporate bonds by Keim and Stambaugh (1986) and Maxwell (1998). The latter found evidence that, among other reasons, window dressing by portfolio managers around the turn of the year provides an explanation for the January Effect. Most of the previous studies on corporate bonds (see the references in Maxwell (1998)) found the effect to be stronger and more significant for lower grade bonds. In particular, Maxwell (1998) found that the January effect was insignificant for IG and significant for HY. Combined with the evidence on stocks and government bonds, this suggests that the January Effect is a positive predictor of the default-risky component of corporate bond returns, but a negative predictor of their default-free component.

We define *JANUARY* as a dummy variable in our regression framework. Hence, the estimated coefficient measures the return in excess of the remaining 11 months of the year.

Corporate Bond Market Return (*CORP*)

Clinebell et al. (1996) analyzed the excess return of long-term, high grade corporate bonds over long-term Treasury bonds.[8] As far as we know, this is the only study that tested the predictability of excess returns over Treasury using lagged returns. Their empirical results indicated that the bond default risk premium follows an autoregressive pattern over different holding periods. However, when used to make 1-step ahead forecasts, the autoregressive model performed comparably to the historical mean model.

[8] They labelled this difference the 'bond default risk premium', whereas we use the phrase 'excess return over Treasury'.

We define *CORP* as the past 1-month excess return. We test predictability of both excess returns over Treasury and over the risk-free rate. Just like our dependent variables, the data for past returns come from the Barclays Capital indexes.

3.2 New Predictor Variables

Above we discussed predictor variables from the existing literature on corporate bond predictability. Next, we present several new variables that have not been tested before in this literature. Since we are primarily interested in predicting the credit spread component of corporate bond returns, our set of new variables focusses on themes that are relevant for credit spreads. Examples include equity risk factors, company fundamentals and liquidity. These variables are taken from *explanatory* studies on corporate bonds, from theoretical credit risk models or from predictability studies on *equities*.

Fama-French Equity Risk Factors (*SMB* and *HML*)

Next to the equity market return, we examine the other systematic equity risk factors from Fama and French (1996): Size (Small-Minus-Big, *SMB*) and Value (High-Minus-Low, *HML*). *SMB* and *HML* have been used by various *explanatory* studies on corporate bonds, for example by Elton et al. (2001) on firm-level credit spreads, Schaefer and Strebulaev (2008) on firm-level returns, Huang and Kong (2003) on index credit spread changes and Sangvinatsos (2005) on index returns. The latter two studies found that *SMB* and *HML* are more closely related to HY than to IG, suggesting that both factors are more relevant for the default-risky component of corporate bond returns than for the default-free component. Since in our study we test whether *SMB* and *HML* can predict excess returns *over Treasuries*, we expect to find consistent results for IG and HY.

Both *SMB* and *HML* are available from Kenneth French' website.

Equity Volatility (*EQVOL*)

As mentioned in Section 2.2, in the Merton (1974) framework a corporate bond can be decomposed in a default-free and a default-risky component. To be more precise, the latter is a written put option on the assets of the firm. An increase in the asset volatility leads to a higher value of the put option, and thus to a negative return on the corporate bond. Since the Merton framework also establishes a positive relationship between asset volatility and equity volatility, an increase in equity volatility should lead to a negative corporate bond return.

Equity volatility has been used in several *explanatory* studies. Huang and Kong (2003) found that an increase in historical equity volatility is contemporaneously correlated with an increase in credit spreads of corporate bond indexes. Studying credit default swap indexes, Figuerola-Ferretti and Paraskevopoulos (2010) concluded that the iTraxx Main index is cointegrated with the VIX equity implied volatility index.

The theoretical and empirical evidence mentioned above suggests that equity volatility is relevant for the credit spread component of corporate bond returns. We therefore test whether VIX is a significant predictor of corporate bond excess returns over Treasury.

We define *EQVOL* as the 1-month proportional change in VIX. Data since 1990 are downloaded from Bloomberg. Prior to 1990, we use the VIX' predecessor, the VXO index, which is available on the CBOE website.

Leverage (*LEV*)

The Merton (1974) model also suggests leverage as a relevant factor for credit spreads. In the model, an increase in a company's leverage increases the default probability for that company. Hence, the company's credit spread will be driven wider. We therefore expect a negative relationship between leverage and corporate bond excess returns. Duvall and Rathinasamy (1993) showed empirical evidence that leverage is indeed a relevant variable in assessing a company's default risk. Furthermore, leverage was used as a control variable in the explanatory regressions of Collin-Dufresne et al. (2001) and Campbell and Taksler (2003). We test whether these explanatory results can be extended to a *predictive* relationship by testing leverage as a predictor of excess returns over Treasury.

We define *LEV* as net debt divided by EBITDA[9]. Just like for the dividend yield and dividend payout variables, we calculate leverage as the equally weighted average over the constituents of the FTSE World Country Index USA. The data are obtained from Compustat and Worldscope.

Liquidity (*TED*)

Our next variable that is expected to be relevant for the spread component of corporate bond returns is liquidity. Both theoretical and empirical evidence demonstrate that liquidity risk is priced in corporate bonds. Ericsson and Renault (2006) extended Merton's (1974) structural model to include liquidity risk. Empirical evidence of priced liquidity can for example be found in early work by Crabbe and Turner (1995) and more recently by Chen, Lesmond, Wei (2007) and De Jong and Driessen (2007).

On the market level, the TED spread, defined as the difference between LIBOR and the T-Bill rate, is often used as a liquidity indicator to explain corporate bond returns or spreads, see for

[9] Earnings Before Interest, Taxes, Depreciation and Amortization

example Campbell and Taksler (2003) and Sangvinatsos (2005). In times of financial crises, like the ones mentioned in Section 2.1, a flight to quality or liquidity drives the TED spread wider. This increases the required compensation for holding corporate bonds and thus generates negative excess returns over Treasury.

These theoretical and empirical studies show that liquidity is a relevant variable for *explaining* credit spreads. Here we test whether the TED spread can also be used as a *predictor* variable of corporate bond excess returns over Treasury.

We define *TED* as the difference between 3-month LIBOR and the 3-month T-Bill yield. Both series are obtained from Bloomberg.

Interest Rate (*RF*)

In the equity literature, the risk-free interest rate is a well-known predictor of returns, see for example Campbell (1987). Furthermore, theoretical and empirical studies point at the importance of the risk-free rate for corporate bond returns. In the Longstaff and Schwartz (1995) model, a higher interest rate leads – via a higher company value and a lower default probability – to a lower credit spread and thus to a positive return on corporate bonds. In their empirical work, they confirmed this relationship. Duffee (1998) also found that the interest rate level is negatively correlated to credit spreads, especially for lower-rated bonds.

These previous studies all suggest that the risk-free rate is especially relevant for the default-risky component of corporate bond returns. We therefore test whether it is a useful predictor of excess returns over Treasury.

We define *RF* as the 1-month T-bill rate, as available from Kenneth French' website.

HALLOWEEN

Another well-known predictor of equity returns is the "Halloween Indicator", as documented by Bouman and Jacobsen (2002). According to this indicator, equity risk premiums are positive from November to April ("winter") and close to zero from May to October ("summer"). More recently, Kamstra et al. (2011) found the opposite seasonal effect for government bond returns. Doeswijk (2008) offered an explanation for this phenomenon: towards year end, investors start looking forward to the next year, often with overly optimistic expectations. This results in more risk-seeking behavior at the beginning of the year. Risky assets, like stocks and corporate bonds, are therefore more attractive in winter months than in summer months.

As far as we know, the Halloween indicator has not been tested before for corporate bonds. We expect a positive relation for the risky component of corporate bond returns and a negative relation for their risk-free component. Therefore, it is important to test predictability of excess returns over Treasury.

We define *HALLOWEEN* as a dummy variable in our regression framework. Hence, the estimated seasonal coefficient measures the return in excess of the remainder of the year.

3.3 Summary Statistics

Table 3 provides descriptive statistics of the predictor variables.[10] Panel A shows statistics for the variables from the existing predictability literature. Panel B provides statistics for the new predictor variables.

[10] The seasonal indicators *JANUARY* and *HALLOWEEN* have been left out of the summary statistics, since these variables are tested as dummies.

[Insert Table 3 around here]

4 Methodology

4.1 Regressions

Following the literature on the predictability of interest rates (e.g. Illmanen, 1995), equity markets (e.g. Goyal and Welch, 2008) and previous studies on the predictability of corporate bonds (e.g. Fuller and Kling, 1994), we use expanding window, linear regressions as our methodological framework. The regressions are run separately for excess returns over the risk-free rate and for excess returns over duration-matched Treasury bonds. Also, the regressions are run separately for IG and HY. We thus have four excess return series that we aim to predict.

Specifically, at the end of month τ, we conduct a least squares regression[11]

(2) $$r_t = \alpha + \beta x_{t-1} + \varepsilon_t, t = 1, \ldots, \tau$$

of monthly corporate bond index excess returns r_t on lagged values of a predictor variable x_{t-1}. Therefore, each regression equation is predictive: we aim to predict the excess return over month t on information that was available at the end of month $t - 1$.

Note that each regression starts from the first observation. The number of observations of the first regression is chosen to be 60 months and grows as τ moves forward to the final month T of the data set. So, the first regression uses excess returns from August 1988, being the first month in our data set, to July 1993, 60 months later. The second regression uses 61 months, et cetera, until the last regression uses 263 observations from August 1988 to June 2010, enabling us to evaluate

[11] To simplify the notation, we use one symbol r_t to represent the different excess returns series. Also, we suppress the dependency of the regression coefficients on τ and the specific excess return series.

the prediction of this last regression on July 2010, being the last month in our data set. In total, we thus run 204 regressions per excess return series.

As shown by Ben Dor et al. (2007), the volatility of corporate bonds' excess returns over Treasury is not constant over time. They provided strong evidence that excess return volatility is higher when credit spreads are higher, and vice versa. More precisely, they showed that the systematic excess return volatility of a corporate bond is proportional to its Duration Times Spread (*DTS*). An ordinary least squares regression on excess returns over Treasury, which assumes that disturbances are identically distributed, is therefore misspecified. To correctly take the heteroskedastic nature of these returns into account, we apply generalized least squares (GLS) to estimate the regression equation. We assume that the index' excess return volatility is proportional to its *DTS*.[12] The distribution of the error terms in Equation (2) then becomes

$$(3) \qquad \varepsilon_t \sim N(0, \sigma^2 DTS_{t-1}^2).$$

To control for any remaining heteroskedasticity and for possible autocorrelation in the residuals, we use the Newey and West (1987) estimator to calculate the standard errors of the estimated coefficients. We follow Newey and West (1994) for the calculation of the number of lags. For comparability with the earlier literature on corporate bond predictability, we estimate a homoscedastic model when running the regressions on excess returns over the risk-free rate. We do use the Newey and West (1987) estimator to calculate the standard errors.

[12] Keim and Stambaugh (1986) also ran heteroskedastic regressions, but used the volatility of last month's equity returns as scaling factor instead of DTS.

4.2 In-Sample Statistics

By running the regression in month τ, we obtain the in-sample R^2, which indicates how much of the variation in excess returns over the past τ months can be predicted by variation in the predictor variables. Further, to judge the significance of a predictor variable, we calculate the in-sample *t*-statistic. We follow Goyal and Welch (2008) by reporting the last in-sample R^2, denoted by $R^2_{IS,T}$, and the last in-sample *t*-statistic, denoted by $t_{IS,T}$.

4.3 Out-of-Sample Statistics

Although $t_{IS,T}$ and $R^2_{IS,T}$ are useful *in-sample* statistics, they do not tell us whether the predictor variable can actually forecast future excess returns *out-of-sample*. Therefore, following Fuller and Kling (1994), Illmanen (1995) and Goyal and Welch (2008), amongst others, we also make an out-of-sample forecast of the excess return over month $\tau + 1$ using the estimated regression coefficients of month τ and the values of the predictor variable at the end of month τ. In this way, we only use information available at the end of month τ to forecast the excess return over month $\tau + 1$.

Like Campbell and Thompson (2008) and Goyal and Welch (2008), we also evaluate the forecasting performance of the *historical mean model*, which simply uses the mean of all realized excess returns $r_1 \ldots r_\tau$ over the estimation window as the forecasted excess return for month $\tau + 1$. This model serves as a naïve benchmark to the regression model.

For both the regression model and the historical mean model, we calculate the forecast error as the difference between the forecasted excess return and the actual excess return. We calculate the *out-of-sample* R^2 as

$$R^2_{OOS,T} = 1 - \frac{MSE_{r,T}}{MSE_{h,T}}$$

where $MSE_{r,T}$ and $MSE_{h,T}$ are the mean squared errors of the forecast errors of the regression model and the historical mean model, respectively, calculated using all out-of-sample forecasts.

We use the Clark and West (2007) *t*-statistic to test the null hypothesis that the forecasting power of the regression model is equal to that of the naive, historical mean model. The Clark and West (2007) statistic is an improvement over the Diebold and Mariano (1995) statistic, because it corrects for the bias caused by the estimation of the β-parameter in the regression model. It is computationally more convenient than the bootstrapping procedure of McCracken (2007), but it performs about as accurately, as shown by Clark and West (2007). To calculate the test statistic, we follow Clark and West (2007) by running an auxiliary regression (see their formula 2.1) and using the Newey and West (1987) estimator in the calculation of the *t*-statistic of the intercept. When evaluating forecasts for excess returns over Treasury, we correct for the heteroskedastic behavior of excess returns by applying GLS in the auxiliary regression, just like in Equation (3). We denote the Clark and West (2007) *t*-statistic by $t_{OOS,T}$, reflecting its purpose to test the significance of the out-of-sample forecasts from the regression model. As recommended by Clark and West (2007), we use a critical *t*-value of 1.28 for a one-sided test at the 10% significance level, 1.65 at the 5% level and 2.33 at the 1% level.

5 Results

5.1 Predictability of Excess Returns over the Risk-Free Rate vs. Predictability of Excess Returns over Treasury

In Section 2 we discussed the nature of corporate bond excess returns and we argued that excess returns over Treasury are more appropriate if we aim to predict variations in credit spreads.

However, most previous studies on the predictability of corporate bond returns focused on excess returns over the risk-free rate, hence sometimes yielding predictors of interest rate changes instead of predictors of credit spread changes. For those variables that have been documented in the literature we first compare the results for both types of excess returns: over Treasury vs. over the risk-free rate.

For each known predictor variable described in Section 3.1, we use the methodology described in Section 4. Panel A of Table 4 shows in-sample and out-of-sample test statistics for the predictability of excess returns over the risk-free rate and Panel B for excess returns over Treasury. A first important conclusion from these results is that we confirm predictability of corporate bond returns on our sample for both types of excess returns. For IG and HY we find several variables that are in-sample and out-of-sample statistically significant at the 90% significance level (or higher). Next, and more importantly, we discuss the results for the individual variables in more detail, zooming in on the differences between predicting excess returns over the risk-free rate and predicting excess returns over Treasury.

[Insert Table 4 around here]

EQ provides strong evidence for our argument that the choice of excess returns matters. For *EQ* we observe two discrepancies that can be explained by the nature of corporate bond returns. The first discrepancy is between IG and HY for excess returns over the risk-free rate. The out-of-sample *t*-statistic for HY is significant at the 99% level, indicating that, on average, the equity market leads the corporate bond market. For IG, however, we do not observe significant results. As described above, this can be explained by the strong anti-cyclical interest rate component in the IG returns, offsetting the pro-cyclical credit spread component. For HY, this is less of an issue, because the spread component dominates the interest rate component. Keim and Stambaugh (1986) found the same inconsistency between IG and HY on their 1928-1958 sample.

The second discrepancy for *EQ* relates to the difference in results for IG between excess returns over the risk-free rate and over Treasury. While *EQ* is not a significant predictor of IG excess returns over the risk-free rate, we do find strong in-sample and out-of-sample predictability of IG excess returns over Treasury. Again, this can be explained by the anti-cyclical interest rate component in the excess returns over the risk-free rate, which is absent in the excess returns over Treasury. When using excess return over Treasury, we only need to predict the pro-cyclical component of corporate bonds returns, so that *EQ* is a highly significant predictor of both IG and HY.

Moving on to *TERM*, we find statistically significant in-sample and out-of-sample predictability of both IG and HY excess returns over the risk-free rate. This suggests that *TERM* has predictive power for both the pro-cyclical and the anti-cyclical component of corporate bond returns. However, this is not entirely confirmed by the results over Treasury. In-sample, we indeed find significant predictability for both IG and HY. But for the out-of-sample results, IG is significant, while the *t*-statistic for HY just falls short of the 90% significance level.

For *DEFAULT*, our results on excess returns over the risk-free rate resemble those of Fuller and Kling (1994) and Sangvinatsos (2005): in-sample, *DEFAULT* is significant for both IG and HY, but out-of-sample only the IG excess returns over the risk-free can be significantly predicted using *DEFAULT*. This is an indication that *DEFAULT* primarily predicts the interest rate component of corporate bond returns. This conjecture is confirmed by the results on excess returns over Treasury, as we find that *DEFAULT* is insignificant for both IG and HY. This is in line with Fridson and Bersh (1994) who found no predictive power for the default premium in timing high yield credit spread movements.

Both *DIVYIELD* and *DIVPAY* show insignificant out-of-sample R^2s for both IG and HY excess returns over the risk-free rate, though *DIVYIELD* does show in-sample significance. These results suggest that *DIVYIELD* and *DIVPAY* can predict neither the interest rate nor the credit spread component in corporate bond returns. The results for excess returns over Treasury are similar to those for excess returns over the risk-free rate, hence confirming that dividend ratios disqualify as predictors of corporate bond returns. Our results do not agree with Fama and French (1989) and Lamont (1998), who showed the forecasting power of *DIVYIELD* and *DIVPAY*, respectively. The difference in sample periods between their research and ours may be the reason for these seemingly incompatible results. However, our results are in line with Goyal and Welch (2003, 2008) who more recently disqualified the usage of dividend ratios as predictors of the equity premium.

JANUARY is again a variable supporting our case for distinguishing between the interest rate and credit spread components of corporate bond returns. For the predictability of excess returns over the risk-free rate, we find insignificant results for IG, but significant results for HY. This supports our earlier conclusion from the literature review that the January Effect works positively on the default-risky component of corporate bond returns and negatively on the default-free component. This implies that we should see consistent results for IG and HY when predicting excess returns over Treasury. This is mostly confirmed by the results. In-sample, we now see significant *t*-statistics for both IG and HY. Out-of-sample, HY is still significant, while the *t*-statistic for IG strongly improved, although not enough to become significant.

Finally, we discuss the results for *CORP*. This turns out to be one of the strongest predictors of corporate bond excess returns, both over the risk-free rate and over Treasury. All in-sample and out-of-sample *t*-statistics are significant for both IG and HY. This suggests that *CORP* can predict the sum of the interest rate and the credit spread components, regardless of their relative weights.

Our results are stronger than those in Clinebell et al. (1996), who found that an AR(1) model of corporate bond excess returns over Treasury performed comparably to a historical mean model.

In summary, we find that *EQ*, *CORP* and *JANUARY* have predictive power for the pro-cyclical component of corporate bond returns, *DEFAULT* for the anti-cyclical component and *TERM* and *CORP* for their sum. Results for *JANUARY* and *TERM* are only partially supported by the results, because both lack out-of-sample significance on one of the universes. *DIVYIELD* and *DIVPAY* do not help to systematically predict excess returns, neither over the risk-free rate nor over Treasury. Our overall conclusion is that the choice of excess returns can lead to different findings, depending on the relative importance of interest rate returns and credit spread returns.

5.2 New Predictors of Excess Returns over Treasury

Next we test the predictive power of several new variables that, as far as we know, have not been tested before in the literature on corporate bond predictability. We focus here on predicting excess returns over Treasury, because we are interested in the component of corporate bond returns that is driven by changes in credit spreads. The results are shown in Table 5 using the same statistics as before. On aggregate, three out of seven variables exhibit in-sample and out-of-sample significance for both IG and HY. Therefore, our study – by focusing on the spread component – yields new variables for predicting corporate bond returns. Below we discuss the results for the individual variables in more detail.

[Insert Table 5 around here]

Several *explanatory* studies on the relation between *SMB* and *HML* and corporate bond returns showed a significant relationship, especially for the HY universe, see for example

Sangvinatsos (2005). However, our *predictive* regressions do not reveal any significance for *SMB* and *HML*, neither in-sample nor out-of-sample, neither for IG nor for HY.

EQVOL turns out to be one of the strongest predictors of corporate bond excess returns over Treasury, both in-sample and out-of-sample for both universes. This implies that not only equity returns (*EQ* as discussed above), but also changes in equity volatility have predictive power for the credit spread component of corporate bond returns.

The other variable that we derived from the Merton (1974) framework, *LEV*, shows disappointing results. Many of its *t*-statistics are even negative. Hence, none of the variables that are computed from bottom-up company fundamentals (i.e. *LEV, DIVYIELD, DIVPAY*) turn out to have significant predictive power for corporate bond returns.

The liquidity indicator, *TED*, is significant on the in-sample and out-of-sample criteria, both for IG and HY. This means that market-wide changes in liquidity can predict corporate bonds' excess returns over Treasury.

While *RF* is a well-known predictor of equity returns (see e.g. Campbell, 1987), we find no significant out-of-sample performance for corporate bond returns over Treasury.

Our final variable, *HALLOWEEN*, has significant in-sample and out-of-sample predictive power for both IG and HY. To the best of our knowledge, this is the first time that the Halloween-effect is documented for corporate bonds.

Summarizing the results, we find that *EQVOL, TED* and *HALLOWEEN* are significant predictors of corporate bond returns. These are novel insights in the literature on corporate bond return predictability. Interestingly, for all new predictors, we find that the R^2 values are higher for HY, suggesting that these themes are relatively more important for HY than for IG. This can be explained by the poorer liquidity of HY bonds and their stronger equity-like nature. Furthermore, several known predictors of equity returns, like *SMB*, *HML* and *RF*, do not show significant predictive power for corporate bonds. This result is in line with Collin-Dufresne et al. (2001), Cheyette and Postler (2006) and Kapadia and Pu (2012), who documented imperfect integration between equity markets and corporate bond markets.

5.3 Robustness Checks

Above we showed that *EQ*, *CORP*, *EQVOL*, *TED* and *HALLOWEEN* have significant in-sample and out-of-sample predictability of corporate bond excess returns over Treasury for both IG and HY.[13] In this section we carry out several robustness checks on the stability of the predictive power of these five variables.

The Impact of the Sub-Prime Crisis

First, we check to what extent our results are driven by the sub-prime crisis. As shown earlier, the last three years of our sub-sample can have a substantial impact on calculations. Table 6 shows the in-sample and out-of-sample *t*-statistics for the five predictors over the full sample and over the sub-sample until June 2007, hence omitting the sub-prime crisis and its subsequent recovery. Virtually all *t*-statistics are lower for the sub-sample than for the full sample, which indicates that the last three years of our sample have indeed been influential on our results. However, four out of five variables remain significant, both in-sample and out-of-sample and for both IG and HY. The exception is *TED*, which remains in-sample significant, but becomes insignificant in the out-of-sample test for both IG and HY (although for HY it just falls short of significance at the 90% level). Hence, before the sub-prime crisis *TED* did not help in predicting corporate bond excess returns, but during and after the crisis it did. This suggests that in the years around the sub-prime

[13] The variables JANUARY and TERM lack significance in one of the universes and are therefore not selected for this follow-up phase.

crisis corporate bond spreads contained a large liquidity component, especially for HY, as shown in Dastidar and Phelps (2011), Dick-Nielsen et al. (2011) and Friewald et al. (2011).

Since the predictability of *TED* mainly comes from the last three years of our sample, TED does not prove to be a very stable predictor over time. For this reason *TED* does not pass this robustness check and we drop it from the list of predictor variables.

[Insert Table 6 around here]

Predictability on the Rating Level

So far, we only analyzed predictability of excess returns on the IG and HY index level. In the next robustness check, we zoom in on the underlying rating indexes. We aim to verify whether the results are broadly based, rather than that they are driven by just a few rating classes. Table 7 shows in-sample and out-of-sample *t*-statistics for all IG ratings (i.e. AAA, AA, A and BBB) and all HY ratings (i.e. BB, B and CCC).[14] We generally observe an increasing pattern of *t*-values with ratings, implying that lower-rated corporate bonds can be predicted more accurately. In fact, *CORP* and *EQVOL* lose their in-sample predictive power when applied to AAA-rated corporate bonds. Both variables are also insignificant in the out-of-sample test, although the sign of the *t*-statistics remains positive. The latter also holds for *EQ*, which is significant in-sample, but insignificant out-of-sample for AAA. For AA, we observe that *CORP* has an insignificant out-of-sample *t*-statistic.

Summarizing the results, we find that most predictors remain significant for most rating classes. The increasing level of significance with ratings is not surprising given that we have selected

[14] We do not consider ratings lower than CCC, because these rating indexes are thinly populated, implying that the returns mostly reflect idiosyncratic risk instead of systematic risk.

predictors of excess returns over Treasury, which are driven by changes in credit spreads. Because the higher-rated bonds (most notably AAAs) contain less credit risk, our predictors are likely to have lower forecasting power for this group.[15] We conclude that all remaining variables are robust for the majority of ratings.

[insert Table 7 around here]

Robustness to Illiquidity

Finally, we test whether our results are driven by the illiquidity of corporate bonds. Stale pricing could distort the returns and create a false sense of predictability. To test the impact of illiquidity, we construct sub-indexes of the aggregate IG and HY indexes using the amount outstanding of the comprising bonds, which is a well-known proxy for liquidity, see for example Houweling et al. (2005).[16] Every month we sort all constituents of the IG index into five quintile portfolios based on their amount outstanding. We calculate the market value-weighted average excess return of each portfolio and repeat this procedure every month. The excess return time series of the 20% smallest bonds represents an index of illiquid IG bonds, while the 20% largest bonds form a liquid IG index. We follow the same procedure for HY. We are most interested in the results for the 20% largest bonds, since their higher liquidity makes them less prone to stale pricing.

[15] Interestingly, *TED*, which did not pass our first robustness check, does show in-sample and out-of-sample significance for AAA-rated bonds, suggesting that the excess returns of these bonds are more driven by liquidity risk than by credit risk.

[16] Barclays Capital uses a minimum amount outstanding as an inclusion criterion in their indexes, so that the smallest bonds are already excluded. Furthermore, they offer "Liquid" and "Very Liquid" versions of their indexes with higher amount outstanding thresholds, but these are only available for high yield and only start in 1994 and 2000, respectively.

Table 8 shows the in-sample and out-of-sample *t*-statistics for the four predictor variables as applied to the illiquid and liquid sub-indexes. All variables still show significant in-sample and out-of-sample predictability on the 20% largest bonds, both for IG and HY. The *t*-statistics of the *CORP* variable suffer most from limiting the sample to the most liquid bonds.[17] Furthermore, the difference between its *t*-statistics for liquid and illiquid bonds is larger for HY than for IG. This suggests that the previous results were partially driven by stale pricing in the least liquid bonds of the indexes, especially for HY. However, predictability is still significantly present for the most liquid components of the indexes, both for IG and HY, bolstering the robustness of the predictor variables.

[insert Table 8 around here]

In summary, out of the five candidate-predictor variables put to test in several robustness checks, only *TED* does not pass the test. *TED* does not prove to be a stable predictor through time, since its predictability mainly comes from the last 3 years from our sample. On the other hand, *CORP*, *EQ*, *EQVOL* and *HALLOWEEN* show consistent predictability through time, in different rating-sub-samples and in different liquidity segments of the corporate bond market. They therefore qualify as significant predictors of corporate bond excess returns over Treasury. For *EQVOL* and *HALLOWEEN* , this has not been shown before in the corporate bond predictability literature.

[17] It is interesting to add here that the predictive power of *TED*, our liquidity proxy, also differs substantially between the liquidity-based sub-indexes. For instance, the out-of-sample *t*-statistics for IG are 1.67 and 0.89 for the illiquid and liquid sub-index, respectively. The matching numbers for HY are 2.09 and 1.22. This shows that *TED* is a significant predictor of the returns of illiquid bonds, but not of liquid bonds.

6 Summary and Conclusions

In this study we took a comprehensive look at the predictability of corporate bond index returns. Our set of variables included all variables from earlier academic literature on corporate bond predictability, as well as several new predictor variables. The key contribution of our study is that we explicitly addressed the nature of corporate bond returns. This is important, because corporate bond returns consist of two distinct components: an interest rate component, which is default-free and anti-cyclical, and a credit spread component, which is default-risky and pro-cyclical. Most importantly, these components are mutually negatively correlated and their contribution varies with credit quality: for investment grade corporate bonds the interest rate component is the dominant factor, while for high yield corporate bonds credit spread variations dominate.

Virtually all previous studies on the predictability of corporate bonds aimed at predicting the excess return over the risk-free rate, which consists of both the interest rate and the credit spread component. Since for investment grade bonds this return is dominated by interest rate variations, these previous studies mostly found predictors of changes in interest rates, instead of predictors of changes in credit spreads. Moreover, they sometimes found inconsistent results between the predictability of investment grade and high yield bonds, because of the difference in importance of the two return components.

In our study we focused on predicting excess returns over duration-matched Treasury bonds, hence aiming to predict returns that can be contributed exclusively to changes in credit spreads. These returns are most relevant for corporate bond portfolio managers, because their active view on interest rate movements can be implemented separately, for example using Treasury bond futures. Our study documented the predictive power of three new variables, which, as far as we know, have not been tested before in the previous literature on corporate bond predictability: the change in VIX (a proxy for asset volatility as motivated by the Merton (1974) model), the TED spread (a proxy for corporate bond illiquidity) and the Halloween indicator ("sell in May and go away, but remember to come back in November" of Bouman and Jacobsen (2002), a proxy for risk aversion).

Furthermore, we retested all known predictors of corporate bond returns to see whether they not only predict the sum of the interest rate and credit spread components, but also the credit spread component on its own. We concluded that the past equity return and the January Effect positively predict the credit spread component of corporate bond returns, but act negatively on the interest rate component. Further, the default premium only predicts the interest rate component, but has no predictive power for the credit spread component. These findings explain why previous studies found inconsistent results for these variables between investment grade and high yield.

On aggregate, we found four variables that show consistent significant in-sample and out-of-sample predictive power for both investment grade and high yield corporate bond excess returns over Treasury: past equity return, past corporate bond return, change in implied equity volatility and the Halloween indicator. These variables survived our robustness analyses, where we checked for stability of the predictability through time, on the underlying rating indexes and on liquid sub-indexes. Therefore, our results strongly imply that corporate bond markets are predictable.

In a broader perspective, our study has a number of implications. First of all, we highlight the importance of the choice of excess returns to assess predictability of corporate bond markets. For academics, this implies that they should shift their attention from predicting the total return of a corporate bond index to predicting its two components: changes in interest rates and changes in credit spreads. For practitioners, this means that they should separate their views on interest rates and credit spreads and their subsequent portfolio implementation. As a second implication, our results highlight the impact of the 2007-2010 sub-prime crisis and its subsequent recovery on empirical analyses. We suggest that future studies on corporate bonds always conduct their analyses with and without this period to make sure their results are not solely driven by the influential observations in this period. Finally, our results show insignificant predictability using company fundamentals, like leverage and dividend payout. We suspect that these slower variables might yield better results for longer forecast horizons than the 1-month horizon that we analyzed. We leave investigation of this issue for further research.

Appendix A: Variance Decomposition

Let

(A1) $ER_{C,f} = R_C - R_f = ER_{T,f} + ER_{C,T}$

where $ER_{C,f}$ is the excess return of a corporate bond over the risk-free return, R_C is the total return of a corporate bond, R_f is the total return on a risk-free investment over the investment horizon, $ER_{T,f}$ is the excess return of a Treasury bond (that matches the corporate bond's duration) over the risk-free return and $ER_{C,T}$ is the excess return of the corporate bond over the duration-matched Treasury bond. By taking the covariance with $ER_{C,f}$ on both sides of Equation (A1), we get

(A2) $$\mathrm{cov}\left(ER_{C,f}, ER_{C,f}\right) = \mathrm{cov}\left(ER_{C,f}, ER_{T,f}\right) + \mathrm{cov}\left(ER_{C,f}, ER_{C,T}\right).$$

This shows that the variance of excess returns of corporate bonds over the risk-free rate (the term on the left-hand side of the equation) equals the sum of two covariance terms: the first with excess returns of Treasury bonds over the risk-free rate and the second with excess returns of corporate bonds over Treasury bonds. The first covariance represents the interest rate component of corporate bond returns and the second covariance the credit spread component. By dividing both sides of Equation (A2) by var($ER_{C,f}$), the variance of the excess returns of corporate bonds over the risk-free rate, we obtain

(A3) $$1 = \frac{\mathrm{cov}\left(ER_{C,f}, ER_{T,f}\right)}{\mathrm{var}\left(ER_{C,f}\right)} + \frac{\mathrm{cov}\left(ER_{C,f}, ER_{C,T}\right)}{\mathrm{var}\left(ER_{C,f}\right)}.$$

In Equation (A3) both terms on the right-hand side may be recognized as regression betas in univariate regressions: the first term is the beta in a regression of $ER_{T,f}$ on $ER_{C,f}$ and the second term is the beta in a regression of $ER_{C,T}$ on $ER_{C,f}$. Therefore, Equation (A3) provides a convenient way of calculating the relative contributions of the interest rate and credit spread components in corporate bond returns.

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	IG		HY	
	interest rate return	credit spread return	interest rate return	credit spread return
August 1988 - July 2010	67%	33%	5%	95%
August 1988 - June 2007	95%	5%	19%	81%

Table 1 Variance decomposition of excess returns over the risk-free rate of Barclays Capital US Investment Grade (IG) and High Yield (HY) indexes into an interest rate return component and a credit spread return component. The interest rate component is obtained by regressing excess returns of Treasury bonds over the risk-free rate on excess returns of corporate bonds over the risk-free rate. The credit spread component is obtained by regressing excess returns of corporate bonds over Treasury on excess returns of corporate bonds over the risk-free rate.

	over risk-free rate		over Treasury	
	IG	HY	IG	HY
min (%)	-7.92	-15.99	-8.38	-16.50
max (%)	6.71	12.09	5.39	13.21
median (%)	0.39	0.57	0.09	0.16
mean (%)	0.32	0.39	0.02	0.15
standard deviation (%)	1.59	2.70	1.15	2.90
Sharpe ratio	0.20	0.14	0.02	0.05

Table 2 Descriptive statistics of monthly excess returns over the risk-free rate and over Treasury of Barclays US Investment Grade (IG) and High Yield (HY) indexes, August 1988 – July 2010.

	min	max	median	mean	stdev
PANEL A: known variables					
EQ	-18.54	11.04	1.05	0.47	4.42
TERM	-0.48	2.81	0.69	1.00	0.91
DEFAULT	0.31	4.65	0.72	0.95	0.64
DIVYIELD	0.87	3.38	1.45	1.75	0.68
DIVPAY	17.50	45.39	31.26	30.46	8.11
CORP					
IG over risk-free	-8.38	5.39	0.09	0.02	1.15
IG over Treasury	-16.50	13.21	0.15	0.14	2.90
HY over risk-free	-7.92	6.71	0.39	0.31	1.59
HY over Treasury	-15.99	12.09	0.57	0.38	2.70
PANEL B: new variables					
SMB	-16.85	21.99	-0.05	0.15	3.43
HML	-12.37	13.87	0.31	0.30	3.25
EQVOL	-32.67	90.75	-1.13	1.59	18.11
LEV	0.72	1.79	1.38	1.30	0.26
TED	0.10	3.15	0.38	0.52	0.40
RF	0.00	0.79	0.37	0.33	0.18

Table 3 Descriptive statistics of the predictor variables from July 1988 to June 2010.

	in-sample				out-of-sample			
	IG		HY		IG		HY	
	$R^2_{IS,T}$	$t_{IS,T}$	$R^2_{IS,T}$	$t_{IS,T}$	$R^2_{OOS,T}$	$t_{OOS,T}$	$R^2_{OOS,T}$	$t_{OOS,T}$
PANEL A: excess returns over risk-free rate								
EQ	0.00%	-0.02	12.88%	4.33***	-1.37%	-0.94	7.96%	2.51***
TERM	2.28%	2.45***	3.30%	2.47***	1.64%	1.58*	1.73%	1.48*
DEFAULT	7.23%	4.03***	8.32%	3.11***	6.13%	1.56*	5.94%	1.19
DIVYIELD	0.72%	1.57*	1.39%	1.43*	-0.40%	0.80	-3.49%	1.26
DIVPAY	0.42%	-1.00	0.44%	-0.89	-1.24%	-0.24	-3.38%	0.09
JANUARY	0.14%	0.84	1.57%	2.44***	-0.30%	-0.66	1.35%	1.94**
CORP	4.15%	3.04***	14.73%	4.92***	2.68%	1.92**	9.42%	1.92**
PANEL B: excess returns over Treasury								
EQ	5.65%	3.79***	6.33%	3.44***	5.48%	2.41***	10.18%	2.82***
TERM	1.36%	2.09**	0.99%	1.56*	1.22%	1.75**	1.10%	1.15
DEFAULT	0.88%	1.12	0.40%	0.78	2.29%	0.8	-3.23%	-0.18
DIVYIELD	1.05%	1.55*	0.74%	1.43*	0.16%	0.67	0.05%	0.12
DIVPAY	0.44%	-1.23	0.23%	-0.85	0.05%	0.46	-0.54%	-0.48
JANUARY	0.39%	1.56*	0.64%	2.15**	0.55%	1.04	0.85%	1.36*
CORP	4.74%	3.56***	4.11%	3.38***	10.71%	2.19**	8.22%	1.97**

Table 4 Regression results for Investment Grade (IG) and High Yield (HY) index excess returns over the risk-free rate in Panel A and excess returns over Treasury in Panel B. $R^2_{IS,T}$ is the last in-sample R^2, $t_{IS,T}$ is the last in-sample *t*-statistic, $R^2_{OOS,T}$ is the out-of-sample R^2 and $t_{OOS,T}$ is the Clark and West (2007) out-of-sample *t*-statistic *, ** and *** denote significance at 90%, 95% and 99% significance level, respectively.

	in-sample				out-of-sample			
	IG		HY		IG		HY	
	$R^2_{IS,T}$	$t_{IS,T}$	$R^2_{IS,T}$	$t_{IS,T}$	$R^2_{OOS,T}$	$t_{OOS,T}$	$R^2_{OOS,T}$	$t_{OOS,T}$
SMB	0.07%	0.35	-0.03%	0.13	-0.04%	-0.30	-0.41%	-1.22
HML	0.18%	-0.79	0.10%	-0.65	0.31%	0.54	0.24%	-0.77
EQVOL	2.46%	2.82***	4.26%	2.51***	3.38%	2.45***	6.78%	2.50***
LEV	0.20%	-0.75	-0.04%	0.04	0.05%	-0.19	0.10%	-0.57
TED	1.85%	2.45***	4.10%	2.45***	2.04%	1.49*	4.24%	1.56*
RF	0.55%	1.39*	0.48%	1.16	0.78%	0.85	0.84%	0.47
HALLOWEEN	1.94%	2.42***	3.23%	2.70***	1.33%	1.90**	2.95%	2.15**

Table 5 Regression results for Investment Grade (IG) and High Yield (HY) index excess returns over Treasury. *, ** and *** denote significance at 90%, 95% and 99% significance level, respectively.

	in-sample				out-of-sample			
	IG		HY		IG		HY	
	full	sub	full	sub	full	sub	full	sub
EQ	3.79***	3.26***	3.44***	2.73***	2.41***	1.92**	2.82***	2.32**
CORP	3.56***	2.79***	3.38***	1.96**	2.19**	2.18**	1.97**	1.36*
EQVOL	2.82***	2.10**	2.51***	1.73**	2.45***	1.81**	2.50***	1.80**
TED	2.45***	1.80**	2.45***	1.88**	1.49*	0.71	1.56*	1.28
HALLOWEEN	2.42***	2.27**	2.70***	2.37***	1.90**	1.85**	2.15**	2.20**

Table 6 In-sample and out-of-sample *t*-statistics for Investment Grade (IG) and High Yield (HY) index excess returns over Treasury over the full sample (August 1988 – July 2010) and over the sub-sample excluding the sub-prime crisis (August 1988 – June 2010). *, ** and *** denote significance at 90%, 95% and 99% significance level, respectively.

	IG	HY	AAA	AA	A	BBB	BB	B	CCC
Panel A: in-sample									
EQ	3.79***	3.44***	2.83***	2.80***	3.57***	3.98***	2.90***	3.28***	4.11***
CORP	3.56***	3.38***	1.14	1.90**	3.07***	3.51***	2.35***	2.67***	4.78***
EQVOL	2.82***	2.51***	1.15	2.40***	2.61***	3.27***	2.13**	2.28**	3.02***
HALLOWEEN	2.42***	2.70***	2.50***	2.17**	2.51***	2.47***	2.76***	2.64***	2.65***
Panel B: out-of-sample									
EQ	2.41***	2.82***	0.80	1.62*	2.25**	2.74***	2.49***	2.50***	3.07***
CORP	2.19**	1.97**	0.62	1.20	1.90**	2.11**	1.48*	1.48*	2.41***
EQVOL	2.45***	2.50***	0.53	1.83**	2.21**	2.72***	2.26**	2.16**	2.85***
HALLOWEEN	1.90**	2.15**	1.95**	1.74**	1.91**	1.79**	2.09**	1.98**	2.04**

Table 7 In-sample and out-of-sample *t*-statistics results for excess returns over Treasury for Investment Grade (IG), High Yield (HY) and all underlying ratings index (AAA, AA, A, BBB, BB, B, CCC) over the full sample (August 1988 – July 2010). *, ** and *** denote significance at 90%, 95% and 99% significance level, respectively.

	IG			HY		
	all	20% smallest	20% largest	all	20% smallest	20% largest
Panel A: in-sample						
EQ	3.79***	4.26***	4.53***	3.44***	4.48***	3.66***
CORP	3.56***	3.98***	2.55***	3.38***	4.67***	2.57***
EQVOL	2.82***	2.91***	2.90***	2.51***	2.70***	2.58***
HALLOWEEN	2.42***	1.76**	2.07**	2.70***	2.23**	2.34***
Panel B: out-of-sample						
EQ	2.41***	3.26***	2.80***	2.82***	3.93***	3.09***
CORP	2.19**	2.26**	1.48*	1.97**	2.80***	1.64*
EQVOL	2.45***	2.48***	2.22**	2.50***	2.87***	2.33***
HALLOWEEN	1.90**	1.53*	1.41*	2.15**	1.83**	1.91**

Table 8 In-sample and out-of-sample *t*-statistics results for excess returns over Treasury for Investment Grade (IG), High Yield (HY) for all bonds, the 20% smallest bonds and the 20% largest bonds over the full sample (August 1988 – July 2010). *, ** and *** denote significance at 90%, 95% and 99% significance level, respectively.