CDS-Bond Basis and Bond Return Predictability

Gi H. Kim Haitao Li Weina Zhang[1]

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Abstract

We examine the predictive power of the CDS-bond basis for future corporate bond returns. We find that *residual basis*, the part of the CDS-bond basis that cannot be explained by a wide range of market frictions such as counterparty risk, funding risk, and liquidity risk, strongly negatively predicts excess returns. Controlling for systematic risk factors, including credit risk and liquidity risk, we find that a bond portfolio formed on the residual basis generates a significant abnormal bond return of 1.79% at the 20-day horizon. The abnormal returns due to the residual basis reflect mispricing rather than missing systematic risk factors. These results are robust to different horizons and sample periods and to the various characteristics of bonds. Overall, our results imply a beneficial role of CDS in the bond market as the existence of mispricing between CDS and bonds results in a subsequent price convergence in bonds.

JEL Classification: G10, G12

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[1] Kim is from the Finance Group, Warwick Business School, University of Warwick. His email is at gi.kim@wbs.ac.uk. Li is from Cheung Kong Graduate School of Business, Beijing 100738. His email is at htli@ckgsb.edu.cn. Zhang is from Department of Finance, NUS Business School, National University of Singapore. Her email is at weina@nus.edu.sg.

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1. Introduction

The market for credit default swaps (CDS) has seen tremendous growth in recent years. According to the Bank for International Settlements (BIS, 2010), the notional value of outstanding credit derivatives at the end of 2007 was $58 trillion, more than six times that of the corporate bond market. As a result, CDS have fundamentally changed market practices in the investment, trading, and management of credit risks. As CDS are essentially an insurance contract against the default of a company's bonds, the CDS and corporate bond markets tend to move in tandem, closely interacting with each other.

The CDS basis ("the basis" hereafter), the deviation between CDS and bonds spreads, is one of the well-known no-arbitrage relations. In theory, the basis should be close to zero, ignoring some technical issues and market frictions. The violation of this relation, if any, may represent the relative mispricing between corporate bonds and CDS. Much interest has been shown, by both academics and practitioners, in understanding the basis, especially after the recent financial crisis, when an extremely negative basis was observed. Most of the existing studies on the analysis of the basis are centered on the causes of the non-zero basis (e.g., Bai and Collin-Dufresne, 2014; Fontana, 2011; Longstaff, Mithal, and Neis, 2005). No prior study, however, has addressed the implications of the basis for future price movements in related markets. Our study fills this void by investigating the predictive power of the basis for future returns in the corporate bond and CDS markets.

A non-zero basis could be due to many factors. For instance, CDS markets are informationally more efficient (e.g., Acharya and Johnson, 2008; Blanco, Brennan, and Marsh, 2004), and incorporate relevant information into prices more quickly than the bond market. Market frictions and risks encountered in a basis arbitrage may prevent price discrepancies from being corrected instantly (Duffie, 2010). A recent study by Bai and Collin-Dufresne (2014) documents that 34% of the CDS-bond basis can be explained by risks or market frictions (e.g., illiquidity). If a large portion of the basis cannot be explained by known factors, the remaining part of the non-explainable basis can potentially reflect temporary "mispricing," which may converge at zero in the future. Therefore, the non-zero basis may predict a price convergence in future periods of the corporate bond and CDS markets. Such predictability is expected to be stronger for the less efficient bond market than for the more efficient CDS market. Using a refined measure of the non-zero basis, we aim to quantify the predictive power of the mispricing between bonds and CDS for their future returns.

To filter out the impact of market frictions and risks involved in a typical basis arbitrage, we separate the observed basis into two parts based on the empirical explanatory model of basis by Bai and Collin-Dufresne (2014): (1) *predicted basis*, which captures the equilibrium non-zero level of the basis due to market frictions and risks (such as counterparty, funding, and liquidity risk); and (2) *residual basis*, which captures the unexplained part of the basis that may reflect mispricing between bonds and CDS. Although the residual basis may not be fully devoid of market frictions or risk factors that are not specified in the empirical model, it is expected to be less noisy in capturing mispricing after removing the well-known risks and measurable market frictions.[2]

We first document that the residual basis strongly predicts future returns for corporate bonds. We find that a one standard deviation increase in the residual basis predicts a negative future

[2] Anecdotal evidence suggests that basis arbitrageurs will start trading only when the basis crosses a certain threshold (e.g., from 10 to 25 basis points for negative basis arbitrage, as indicated by JP Morgan, 2006, p. 55). A similar economic intuition is used in Lee, Myers, and Swaminathan (1999) in the stock market to capture temporary market price deviation from fundamental value.

excess bond return of –4.8% on an annual basis at a minimum, suggesting that currently overpriced (underpriced) corporate bonds relative to CDS experience a subsequent price decline (increase). The price correction of corporate bonds occurs over various time horizons (e.g., 20 days, 40 days, and 60 days). The predictive power of the residual basis is still robust after controlling for bond illiquidity,[3] information spillover from the CDS market, and price momentum and reversals. However, the predicted basis has a much lower predictive power for future bond returns.

A typical basis arbitrage also involves CDS since arbitrageurs tend to hedge their bond positions with CDS. When the basis is negative (positive), one can long (short) the underlying corporate bond and buy (sell) CDS to bet on the narrowing of the basis. The arbitrage force may lead to an adjustment in subsequent CDS prices. Our empirical results confirm this intuition by showing that the residual basis has strong predictive power for the change in CDS spreads as well. A one standard deviation increase in the residual basis predicts a rate of change in CDS spreads of –11.9% on an annual basis at a minimum, suggesting that the corresponding CDS experience a subsequent spread decrease. However, the predicted basis does not predict CDS price movements at all.

Even though the residual basis has strong predictive power for both markets, the statistical significance of its predictability is much stronger for bond markets than for CDS markets. The t-statistics for the coefficients on the residual basis in our predictive regression models are about two times bigger for bond markets than for CDS markets, regardless of model specifications.

[3] See, for example, Longstaff, Mithal, and Neis (2005); Chen, Lesmond, and Wei (2007); Goldstein, Hotchkiss, and Sirri (2007); Lin, Wang, and Wu (2011); Bao, Pan, and Wang (2011); Dick-Nielsen, Feldhütter, and Lando (2012); and Friewald, Jankowitsch, and Subrahmanyam (2012).

This result is also consistent with the literature documenting that mispricing is observed more often in bond markets than in CDS markets because CDS markets are more efficient in pricing credit risk (e.g., Acharya and Johnson, 2008; Blanco, Brennan, and Marsh, 2004).

We perform several robustness tests to ensure that the strong predictability is consistent with the mispricing and subsequent price convergence interpretation. It is well known that investment-grade (IG) and high-yield (HY) bonds are different in many dimensions, such as investors' clientele and liquidity (e.g., Da and Gao, 2010; Acharya, Amihud, and Bharath, 2013). Therefore we analyze each type of bond separately. Our results show that the price corrections occur for both types of bonds across different time horizons (20 days, 40 days, and 60 days), but the result is weaker for the speculative-grade CDS over longer horizons (40 days or 60 days). This result is consistent with the anecdotal evidence that the basis arbitrage is risky and that basis arbitrageurs opt for safer investment opportunities, such as investment-grade credit instruments and shorter horizons (e.g., Deutsche Bank, 2009).

Given the disruption of the corporate bond and CDS markets during the financial crisis,[4] we also investigate whether price corrections were disrupted during the crisis. Our results show that the predictability of the residual basis for bond price correction was still robust during the crisis. Interestingly, the predictability for CDS spread movement was not statistically significant during the crisis. These results indicate that basis arbitrage plays a reduced role in stabilizing the CDS market during a crisis, consistent with the literature that the limits of arbitrage have been hit by investors (e.g., Duffie, 2010; Mitchell and Pulvino, 2012).

[4] For example, see Fontana (2011); Trapp (2010); Dick-Nielsen, Feldhütter, and Lando (2012); Friewald, Jankowitsch, and Subrahmanyam (2012). The basis was extremely negative for a prolonged period during the recent financial crisis: the basis of the investment-grade index in late 2008 dropped to –250 bps, whereas that of the speculative-grade index dropped to about –400 bps.

Given the strong predictive power of the residual basis for future bond returns, it is natural to verify whether we could implement a profitable convergence trade in bond markets based on the residual basis as a trading signal. Indeed, we find that a strategy of buying low-residual corporate bonds and selling high-residual corporate bonds earns a statistically significant high *abnormal* return of 1.79% over a 20-day horizon. The return is even higher for longer horizons in which we have 2.40% for a 40-day, and 2.68% for a 60-day horizon. This result is robust after controlling for well-known systematic risk factors for corporate bonds, including default and liquidity risk factors as well as various bond characteristics such as credit ratings, maturity, age, coupon, and issue size. Even after taking into account the fact that corporate bonds may incur high transaction costs, these returns are still sizeable (especially for an institutional investor).[5] However, a similar trading strategy based on the predicted basis generates much less economically and statistically significant abnormal returns. Specifically, the abnormal return from predicted basis arbitrage strategy is 0.67% for a 20-day horizon, which is less than a half the return from the residual basis. These results suggest that the residual basis can serve as a much better trading signal for arbitrageurs who wish to exploit the mispricing between the bond and CDS markets.

The final test we perform is to confirm that the source of the high abnormal bond returns is due to “pure” mispricing rather than to *unknown or missing* risk factors. Following the standard approach in the literature (e.g., Fama and French, 1993; Daniel and Titman, 1997; Gebhardt, Hvidkjaer, and Swaminathan, 2005), we compare the explanatory power of the cross-section of bond returns of the residual basis itself with a factor-mimicking portfolio, the Low-minus-High (LMH) factor, which is based on the residual basis. Our results show that when the residual basis

[5] Edwards, Harris, and Piwowar (2007) show that the average round-trip cost for a representative retail order size of $20,000 is estimated as 1.24% of the price. The transaction cost decreases with trade size, and is as low as 0.48% for an institutional order size of $200,000. A long-short corporate bond trading strategy involves two round-trip transaction costs, which would amount to about 0.96% for institutional investors.

itself is included in the return regression, the LMH factor does not explain the bond returns, while the residual basis is significantly related to the bond returns. This finding suggests that the residual basis represents temporary mispricing in corporate bonds rather than unknown risk factors.

Our study makes three distinct contributions to the existing literature. First, our results contribute to the rapidly growing literature on the CDS-bond basis. The non-zero CDS-bond basis is still a puzzle that is yet to be understood in full. For the aggregate level of the basis, Fontana (2011) studies the basis during 2007/09 financial crisis for investment-grade U.S. firms and shows that the basis is correlated with a few factors, including the Libor-OIS spread. Fontana and Scheicher (2010) examine the sovereign basis for ten European countries to understand the determinants of the basis. For the cross-section of the basis, Bai and Collin-Dufresne (2014) utilize a risk-return analysis on the basis and suggest potential explanations for the basis, such as market frictions and bond characteristics. Nevertheless, they are able to explain only 34% of the basis variations. There are many more unknown "limits to arbitrage" reasons that contribute to the non-zero basis. Our findings shed new light on the source of the non-zero basis by showing that a residual basis represents a better measure of mispricing.

Second, our study extends the literature on limits to arbitrage by documenting that the existence of mispricing between CDS and bonds results in subsequent price corrections in both markets. Baker and Savasoglu (2002), Lamont and Thaler (2003), and Mitchell, Pulvino, and Stafford (2002), among others, empirically document the limits of arbitrage in equity markets. For fixed-income markets, Fleckenstein, Longstaff, and Lustig (2014) document the existence of mispricing between real and synthetic Treasury bond, and show that the mispricing narrows as additional capital flows into the markets. To the best of our knowledge, our paper is the first to document the price convergence between derivatives and underlying cash securities in the credit markets.

Last, our study also contributes to the recent debate over whether CDS improve the overall efficiency and quality of other related markets. Boehmer, Chava, and Tookes (2013) find that CDS generally have a negative impact on equity market quality measured in terms of stock liquidity and stock price efficiency. Das, Kalimipalli, and Nayak (2014) also argue that CDS are largely detrimental to the corporate bond market, which has become less efficient and has not experienced a reduction in pricing errors or an improvement in liquidity.[6] Our finding that price adjustments are stronger in the corporate bond market than in the CDS market, however, suggests that the presence of CDS may improve the pricing efficiency of the corporate bond market.

The rest of the paper is organized as follows. Section 2 discusses the construction of the residual basis. Section 3 presents our main result that the residual basis predicts price convergence between CDS and corporate bonds. Section 4 shows that the return predictability by the residual basis is not due to missing risk factors but captures mispricing in corporate bonds. Section 5 presents several robustness tests and section 6 concludes.

2. Residual Basis: A Refined Measure of Mispricing

In this section, we explain how our basis measure is constructed, from which we describe how to develop a refined measure of the mispricing between CDS and corporate bonds, devoid of

[6] Our paper also differs from Kim, Li, and Zhang (2013), who study CDS-bond basis arbitrage. They interpret the basis as a summary of the various risks involved in the corporate bond market, and show that it explains the cross-section of corporate bond returns. In this study we focus instead on the unexplained part of the basis and show that (i) it captures mispricing between CDS and corporate bonds and (ii) predicts price convergence between CDS and corporate bonds.

various market frictions and risks that may prevent arbitrageurs from exploiting price discrepancies.

2.1. Methodology

The basis for a given firm *i* at time *t* for a given maturity τ is defined as

$$Basis_{i,t,\tau} = CDS_{i,t,\tau} - Z_{i,t,\tau}, \tag{1}$$

where $CDS_{i,t,\tau}$ is the CDS spread of firm *i* at time *t* with maturity τ, and $Z_{i,t,\tau}$ is the Z-spread. The Z-spread, which is widely used in industry to define the basis (e.g., Choudhry, 2006), represents a parallel shift of the credit curve such that the present value of future cash flows equals the current price. For a 5-year plain vanilla bond with an annual coupon, we obtain the Z-spread by solving the following equation:

$$P = \frac{c}{(1+s_1+Z)} + \frac{c}{(1+s_2+Z)^2} + \frac{c}{(1+s_3+Z)^3} + \frac{c}{(1+s_4+Z)^4} + \frac{c+1}{(1+s_5+Z)^5}, \tag{2}$$

where *P* is the current price of the bond with a face value of 1, *c* is the coupon rate, s_i is the zero-coupon yield to maturity based on the swap rate curve for a maturity of *i* year(s) (where *i* = 1, 2,…, 5). Then we match the Z-spread with the CDS spread at the same maturity. If we do not have an exact match for maturity, we linearly interpolate the CDS curve to obtain a CDS spread that has the same maturity as the bond.

Given that CDS and bonds are two different ways to invest in the credit risk of the same company, and should have the same payoff in both default and at maturity, the basis will be close to zero in equilibrium. Expected to disappear in future periods, a non-zero basis may represent the mispricing between CDS and bonds that could allow potential arbitrage opportunities. In practice, however, the basis could have a non-zero value due to (i) contractual differences between cash bonds and CDS, such as maturity mismatching and different frequency of cash payments,[7] or (ii) risks encountered in a basis arbitrage (such as counterparty, funding, and liquidity risks).

Based on an empirical model developed by Bai and Collin-Dufresne (2014),[8] which is described in Appendix A.1, we separate the basis into two parts: "predicted basis," which represents the equilibrium non-zero level of the basis, and "residual basis," which cannot be explained by known risk factors and on average has a value of zero. To the extent that the predicted basis captures risks and market frictions encountered in a basis arbitrage, our residual basis measure should be a less noisy measure than the overall basis for capturing the pure mispricing between bonds and CDS.

2.2. CDS and Bond Data

The CDS data used in this study are on standardized ISDA contracts for physical settlement. We obtain the CDS data from Markit, which aggregates quotes from major CDS dealers. We focus on U.S. dollar-denominated CDS contracts that are senior unsecured with the "Modified Restructuring" clauses from 2001 through 2008. The daily CDS spreads are quoted in basis points (bps) per year for a notional amount of $10 million. While previous studies have mainly focused on CDS contracts at a five-year maturity, we use the complete curve of CDS spreads for 6-month, 1-, 2-, 3-, 5-, 7-, 10-, 15-, 20-, and 30-year maturities to exact-match the maturities of corporate bonds. The bond data for the years 2001 through 2008 are obtained from three

[7] It might be difficult to find a CDS with exactly the same maturity as the cash bond. In a default event, when the accrued interest is paid upon default in CDS, it may not be paid for the defaulted bond. Interest for CDS is paid quarterly, whereas it is paid semi-annually for most cash bonds. The cheapest-to-deliver option embedded in a CDS contract can be extremely valuable in some default events, which could lead to discrepancies between CDS and bond spreads.

[8] We are aware that Nashikkar, Subrahmanyam, and Mahanti (2011) have proposed an alternative empirical deterministic model for CDS-bond basis. However, one of their key independent variables "latent liquidity" is obtained from a proprietary data source that we do not have access to replicate their empirical model.

different sources. The price information is from TRACE and NAIC, bond transaction databases that have been widely used in recent literature. The bond transaction data are further merged with the Fixed Investment Securities Database (FISD) to obtain bond characteristic information, such as issue dates, maturity dates, issue amount, and rating information. To compute the basis, we focus on senior-unsecured fixed-rate straight bonds with semi-annual coupon payments, and delete bonds without credit ratings from any of the three rating agencies (Standard & Poor's, Moody's, and Fitch). We further remove bonds with embedded options (callable, puttable, or convertible bonds), floating coupons, and less than one year to maturity.

TRACE was officially launched in 2002 by the Financial Industry Regulatory Authority (FINRA), which replaced NASD, to disseminate secondary over-the-counter (OTC) corporate bond transactions by its members. TRACE has gradually increased its coverage of the bond market over time. By July 1, 2005, FINRA required all its members to report their trades within 15 minutes of the transaction. Nowadays, TRACE covers all trades in the secondary over-the-counter market for corporate bonds and accounts for more than 99% of the total secondary trading volume in corporate bonds. The only trades not covered by TRACE are trades on the NYSE, which are mainly small retail trades. The information contained in TRACE includes transaction dates and transaction price (clean price or price with commissions). In this study we exclude transactions whose prices are mixed with commissions.

Owing to limited coverage by TRACE in its early years, we supplement the bond transaction information with the NAIC database, which provides all corporate bond transactions by American life, health, property, and casualty insurance companies since 1994. Insurance companies are estimated to hold between 33% and 40% of corporate bonds and to have completed 12.5% of the dollar trading volume in TRACE-eligible securities during the second half of 2002 (Schultz , 2001; Campbell and Taksler, 2003). A recent study by Lin, Wang, and Wu (2011) also uses the combined dataset of NAIC and TRACE to study the liquidity risk in the corporate bond market. NAIC is an alternative to the no-longer-available Lehman fixed-income database on corporate bonds used in previous studies. Since NAIC does not report the exact time of trading, we use the last transaction price from TRACE as the closing price of the bond for each day. When TRACE has no record of a bond transaction, we use the observation from NAIC if it is available.

2.3. Sample Construction

For each bond *i* on day *t*, the basis, $Basis_{i,t}$ is defined as the difference between a firm's CDS spread and a bond's Z-spread measured on day *t*. We compute the Z-spread by using the daily price of a bond obtained from the last transaction on day *t*. Next, we match the computed Z-spread with the CDS spread on day *t* at the same maturity. If we cannot find the exact match for maturity, we linearly interpolate the CDS curve to obtain a CDS spread that has the same maturity as the bond. Last, the basis is constructed by subtracting the Z-spread from the CDS spread.

Once the basis for a given bond is constructed on day *t*, we compute bond returns ($HPR_{t,t,t+k}$) for the subsequent periods (from day *t* to *t+k*, where *k=20, 40,* or *60* days) using the following equation:

$$HPR_{i,t,t+k} = \frac{\left(P_{i,t+k} + AI_{i,t+k}\right) + C_{i,t,t+k} - \left(P_{i,t} + AI_{i,t}\right)}{\left(P_{i,t} + AI_{i,t}\right)} \ , \qquad (3)$$

where $C_{i,t,t+k}$ is the coupon payment during the period (i.e., between day *t* and *t+k*), and $AI_{i,t+k}$ the accrued interest on day *t+k*. $P_{i,t+k}$ and $P_{i,t}$ is the daily price of a bond obtained from the last transaction of the bond during day t+k and t, respectively. Similarly, the rate of change in CDS spreads ($\Delta(CDS)_{i,t,t+k}$) is computed as:

$$\Delta(CDS)_{i,t,t+k} = \frac{CDS\ Spread_{i,t+k} - CDS\ Spread_{i,t}}{CDS\ Spread_{i,t}} \quad (4)$$

If there are no data available on day *t+k* for either bonds or CDS, we use the nearest available data on day *t+k–1*, *t+k–2, t+k–3, t+k–4*, and *t+k–5* in the order of priority. If there are no data available within the five-day window, the bond or CDS is removed from our sample. The constructed data of basis, bond returns, and CDS changes are further merged with firm characteristics data (from Compustat and CRSP) to compute the residual basis.

[Insert Table 1 about Here]

After matching, cleaning, and winsorizing by 1% at the bottom and the top, our final dataset has a total of 181,092 observations. Our final sample covers the period from January 2, 2003, through December 31, 2008. Panel A of Table 1 provides summary information about the firms and bonds in our sample. There are a total of 765 IG firms with 2,615 bonds and 141,485 daily bond observations and 229 HY firms with 539 bonds and 39,607 daily bond observations.

Panel B of Table 1 reports summary statistics for the overall basis (*Basis*), the predicted basis ($Basis_{predicted}$), and the residual basis ($Basis_{residual}$), as well as a wide range of bond and firm characteristics. Both *Basis* and $Basis_{predicted}$ are about –5 basis points, whereas $Basis_{residual}$ has a zero mean by construction. Interestingly, both *Basis* and $Basis_{predicted}$ have a negative mean of –31 basis points for IG bonds and a positive mean of 81 basis points for HY bonds. $Basis_{residual}$ has a zero mean for both IG and HY bonds because we run the cross-sectional regression model for the IG and HY bonds separately. *Basis* and $Basis_{predicted}$ tend to have higher standard deviations than $Basis_{residual}$. The average bond in our sample is about 5.7 years old and has a rating between

BBB+ and BBB, an average maturity of 9 years, a coupon rate of 6.6%, and an outstanding amount of $392 million.

Panel C of Table 1 reports the correlation coefficients among all the key variables. We find that the correlation between *Basis* and $Basis_{predicted}$ is about 0.82. The correlation between *Basis* and $Basis_{residual}$ is about 0.57. We also find that $Basis_{residual}$ is not highly correlated with all the control variables, whereas $Basis_{predicted}$ is highly correlated with the past CDS spread (at 0.70) and credit rating (at 0.54).

3. Empirical Findings

3.1. Predictive Power of the Residual Basis

In this section, we test whether the residual basis has significant predictive power for future bond prices and CDS spreads. In fact, we find that the residual basis predicts price convergence between corporate bonds and CDS. It is important to note that the predictive power is much stronger for bonds than for CDS. The predicted basis, in contrast, exhibits some predictive power for bonds, but not for CDS.

A non-zero residual basis could be due to many factors. For instance, it could reflect the unobservable market frictions and risks encountered in a basis arbitrage, apart from the precision of the model employed to predict the basis. To the extent that our residual basis measure captures mispricing of the unknown limits to arbitrage, one would expect mispricing to narrow in future periods when the limits are not binding, or are less binding.

The arbitrageurs would long (short) bonds with a negative (positive) residual basis, which tend to be underpriced (overpriced) relative to their fundamental values. Since the arbitrage force would drive up (down) the prices of underpriced (overpriced) bonds, we expect to find a *negative* relation between the residual basis and future bond returns. If the arbitrageurs use CDS to hedge the default risk of the bonds they long or short, then their trading behavior might also affect CDS spreads. The predictive power for each market may differ depending on the degree of mispricing prevalent in the two markets.

We examine the predictive power of the residual and predicted basis for future bond returns and CDS spreads through Fama-MacBeth (1973) regressions with the robust Newey-West (1987) t-statistics for the coefficients with *k-1* lags as follows:

$$HPR_{i,t,t+k} - r_{f,t,t+k} = \alpha + \beta_1 Basis_{residual,i,t} + \beta_2 Basis_{predicted,i,t} + bond\ control_{i,t} \quad (5)$$

$$\Delta(CDS)_{i,t,t+k} - r_{f,t,t+k} = \gamma + \delta_1 Basis_{residual,i,t} + \delta_2 Basis_{predicted,i,t} + CDS\ control_{i,t}\ , \quad (6)$$

where $HPR_{i,t,t+k}$ is the k-day holding period return for individual bond i from day t to $t+k$ (where k=20, 40, or 60), $r_{f,t,t+k}$ is the cumulative risk-free rate from day t to $t+k$, $\Delta(\text{CDS})_{i,t,t+k}$ represents the rate of changes in CDS spreads for firm i from day t to $t+k$, $Basis_{residual,i,t}$ is the residual basis on day t, and $Basis_{predicted,i,t}$ is the predicted basis on day t.

The bond control variables in equation (5) include credit rating, maturity, age, coupon, issue size, and bond liquidity (i.e., turnover) (e.g., Lin, Wang, and Wu, 2011). Following Tang and Yan (2014), the CDS control variables in equation (6) include *Stock Return*, the rate of change in stock price within the past one month; Δ*(Volatility),* the rate of change of stock volatility within the past one month (where stock volatility is defined as the standard deviation of daily stock returns for the past 60-day window); Δ*(Leverage)*, the rate of change in market leverage within the past three months (where market leverage is defined as the book value of total debt divided by the market value of total assets); Δ*(Size)*, the rate of change in the logarithm of the market value of total assets within the past three months; Δ*(Profitability)*, the rate of change in net income divided by the market value of total assets within the past three months; and Δ*(Cash)*, the rate of change in the ratio of cash and cash equivalent divided by the market value of total assets in the past three months.

[Insert Table 2 about Here]

Table 2 reports the regression results for bond excess returns with three different model specifications over 20-, 40-, and 60-day holding horizons. It is shown that the coefficients on $Basis_{residual}$ are significantly negative for all bonds at the 1% significance level, ranging from –2.04 to –1.23 across three different horizons. A one standard deviation decrease in $Basis_{residual}$ can generate an annual return of 4.8% to 14.1% for all bonds. These returns would be economically significant after taking into account the high transaction costs in the bond market. Note that the average monthly return of U.S. corporate bonds is about 0.29% according to Barclays U.S. Credit Index from 2003 through 2008 (Barclays Capital, 2010).

Given that the literature has shown that the CDS market is more efficient than the bond market in pricing credit risk (e.g., Zhu, 2004; Blanco, Brennan, and Marsh, 2005; Longstaff, Mithal, and Neis, 2005; Norden and Weber, 2009; Alexopoulou, Andersson, and Georgescu, 2009; Coudert and Gex, 2010), we also control for CDS spreads in the return regression by including *CDS Spread* on day *t* in Table 2. Consistent with the existing literature, we find that the coefficients of *CDS Spread* are statistically significant for all bonds at the 1% significance level. But the coefficient of $Basis_{residual}$ remains significantly negative for all holding horizons.

We also include lagged bond returns, *Bond Return,* and changes in CDS spread, *Δ(CDS Spread)*, to control for price momentum or reversals in the two markets in Model 2 and Model 3, respectively (e.g., Pospisil and Zhang, 2010).[9] *Bond Return* is the lagged individual bond's excess return from day *t*–20 to day *t–1*. *Δ(CDS Spread)* is the rate of change in CDS spreads from day *t*–20 to day *t*. The coefficient of $Basis_{residual}$ remains almost the same in Model 2 but declines slightly in Model 3. A one standard deviation decrease in $Basis_{residual}$ can still lead to an annual return of 4.8% to 10.3% under Model 3. Therefore, these additional control variables do not reduce the strong predictability of the residual basis for future bond returns.

[Insert Table 3 about Here]

Table 3 reports the regression results for CDS spreads with three different model specifications over 20-, 40-, and 60-day holding horizons. The predictability of $Basis_{residual}$ for future CDS spread changes is very strong and robust: a one standard deviation decrease in $Basis_{residual}$ leads to a positive rate of change in CDS spreads of 11.9% to 17.7% on an annual basis. Models 2 and 3 further control for lagged changes in CDS and bond returns. The coefficients of these additional control variables are significantly negative, indicating that the CDS experience price reversals.

Note in Table 2 and Table 3 that the predictive power of $Basis_{predicted}$ is somewhat limited. It has highly significant coefficients only for bond returns, but not for CDS spread changes. These results suggest that $Basis_{predicted}$ may capture systematic risk factors, rather than mispricing, which affects only corporate bonds. As a result, it would predict only bond prices rather than the CDS. Overall, we find that the residual basis predicts subsequent price convergences between corporate bonds and their corresponding CDS.

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[9] We do not consider including CDS spread, changes in CDS, and bond returns altogether as an explanatory variable to avoid the collinearity issue because, technically, basis is the difference between CDS and bond spreads. Therefore, we include either *Δ(CDS Spread)* or *Bond Return* in the tests.

3.2. Profitability of a Residual Basis Portfolio

In this section, we first explore whether a convergence trade, a trading strategy that bets on the residual basis getting narrower, can generate significant abnormal returns for corporate bonds. We compute the abnormal returns that can be achieved by investing in corporate bonds using the residual basis as a trading signal. Specifically, we sort bonds into five quintile portfolios based on the residual basis. Next, we long the bottom quintile portfolio with the lowest residual basis and short the top quintile portfolio with the highest residual basis. For comparison, we also compute the returns based on the predicted basis as the trading signal.

To compute the abnormal return of each basis quintile portfolio, we use the following return regression:

$$HPR_{p,t,t+k} - r_{f,t,t+k} = \alpha_{p,k} + \beta_{1,p}MKT_{t,t+k} + \beta_{2,p}SMB_{t,t+k} + \beta_{3,p}HML_{t,t+k}$$

$$+\beta_{4,p}DEF_{t,t+k} + \beta_{5,p}TERM_{t,t+k} + \beta_{6,p}LIQ_{t,t+k} + \varepsilon_{p,t} \quad (7)$$

where $HPR_{p,t,t+k}$ is the k-day holding period return of the basis portfolio p from day t to $t+k$ (where k=20), *MKT*, *SMB*, and *HML* are the Fama-French (1993) three factors cumulated daily from day t to $t+k$, *TERM* is the difference between the daily return of the 10-year-to-maturity government bond index and the daily T-bill return cumulated daily from day t to $t+k$, *DEF* is the difference between the daily return of the Lehman investment-grade bond index and the daily 10-year-to-maturity government bond from CRSP cumulated daily from day t to $t+k$, and *LIQ* is the Amihud (2002) liquidity risk factor measured from day t to $t+k$ by following the procedure in Lin, Wang, and Wu (2011). Table 4 reports the results.

[Insert Table 4 about Here]

In Panel A of Table 4, we find that the average abnormal returns over the entire sample of the quintile portfolios of all bonds (which is $\alpha_{p,k}$ in equation (7)) decrease monotonically from 1.58% to –0.21% for the portfolio with the lowest residual basis to the one with the highest residual basis. If we long the portfolio with the lowest residual basis and short the portfolio with the highest residual basis, we would earn an abnormal return of 1.79% in 20 trading days (2.40% for a 40-day and 2.68% for a 60-day horizon).[10] Edwards, Harris, and Piwowar (2007) show that the average round-trip cost for a retail order of $20,000 is 1.24%, and the cost decreases to as low as 0.48% for an institutional order of $200,000.[11] Hence, the long-short strategy of corporate bonds, which involves *two* round-trip transactions, would incur transaction costs of about 2.48% for individuals and 0.96% for institutions. Given that the basis trade is likely to be done by institutional investors with a larger trade size, their take-home profit from the 20-day trading strategy could be approximately 83 basis points net of the transaction cost. The profit will be even larger for longer horizons (144 bps for the 40-day horizon and 172 bps for the 60-day).

In Panel A of Table 4, we also report the yearly breakdown of abnormal returns of the quintile portfolios and reach a similar conclusion, that the low residual basis portfolio has higher returns than the high residual basis portfolio. We also present the abnormal returns of the quintile bond portfolios across various characteristics, such as rating, maturity, age, coupon rate, and issue size.[12] We first sort bonds based on each characteristic, and then on the level of basis on

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[10] The results for a 40-day and a 60-day horizon are not reported to save the space but are readily available upon request.

[11] The round-trip transaction costs vary within institutional-size trades: 28 bps for a trade size of $500,000 and 18 bps for a trade size of $1M.

[12] The details of different bond characteristics considered are as follows: (i) seven rating groups with ratings of AAA, AA, A, BBB, BB, B, and CCC and below; (ii) five maturity groups with maturities of 1–3, 3–5, 5–7, 7–10, and more than 10 years; (iii) five age groups with ages of less than 3, 3–5, 5–7, 7–10, and more than 10 years; (iv) five coupon groups with annual coupons of 0–5.5%, 5.5%–6.5%, 6.5%–7%, 7–8%, and more than 8%; and (v) five issue size groups with issue sizes of 0–0.2, 0.2–0.3, 0.3–0.5, 0.5–0.6, and more than $0.6 billion.

day *t*. For each portfolio, the value-weighted returns are computed from day *t* to day *t+20*. We find that the long-short strategy earns significant abnormal returns at the 1% significance level across all bond characteristics. The strategy is the most profitable for the oldest bonds and for the bonds with a BBB rating, the longest maturity, the smallest issue size, and higher coupon rates.

Panel B in Table 4 reports parallel results for quintile portfolios sorted by the predicted basis on day *t*. Generally, we observe a negative relation between abnormal portfolio returns and the predicted basis; i.e., the portfolio with the lowest predicted basis has the highest abnormal return. A strategy that longs the portfolio with the lowest predicted basis and shorts the portfolio with the highest predicted basis generally earns a positive abnormal return. The strategy, however, loses money in 2006 and for bonds with extremely high or low credit ratings. More important, the economic significance of the abnormal returns becomes much smaller for the long-short strategy based on the predicted basis.[13]

In summary, our results show that a long-short strategy based on the residual basis could yield significant abnormal returns across different years and for bond groups with different characteristics. After taking into account the transaction cost, we find that this trading strategy would still generate economically significant returns for institutional investors.

3.3. Profitability of the Negative Basis Trade

In order to exploit the pricing misalignment between corporate bonds and CDS, investors can engage in a popular arbitrage strategy called "negative basis trade": When the basis is negative,

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[13] In unreported results, we have also computed the abnormal returns for 40-day and 60-day horizons. Similar to the prior results, we find that the abnormal returns are more significant, both economically and statistically, under the trading strategies based on the residual basis than those based on the predicted basis.

one longs the underlying bond and buys CDS to bet on the narrowing of the basis. Although the positive basis can also allow investors to engage in arbitrage, the negative basis trade is more popular than the positive basis trade because it is difficult to short bonds if the basis is positive. As such, we investigate the profitability of the negative basis trade by buying a very negative CDS-bond basis bond and buying its insurance through CDS for a period (20 days, 40 days, or 60 days) and closing both positions at the end of the period. If the mispricing is corrected, we should expect this arbitrage strategy to generate positive excess returns.

Similar to the analysis in section 3.2, we form the quintile portfolios based on the residual basis on day *t*, and measure the realized excess returns from both corporate bonds and CDS for the next *k*-day holding period from *t* to *t+k* (*k*=20, 40, and 60). The realized excess returns on CDS are measured by the change in the mark-to-market value of the contract, which is approximated by the multiple of the change in the CDS spread and the value of a default-risky annuity, *A(T)* (both at T-year maturity):[14]

$$r_{i,t,t+k}^{CDS,e} = (CDS\ Spread_{i,t+k} - CDS\ Spread_{i,t}) \times A(T) \qquad (8)$$

In Table 5, we report the results of excess returns for the quintile portfolio with the most negative basis, which consists of 30 different bonds on average and has an average residual basis of –70 bps. It is shown that our negative basis strategy could generate significant excess returns

[14] The value of a risky annuity for CDS of T-year maturity with a quarterly premium payment is computed as

$$A(T) = \frac{1}{4}\sum_{j=1}^{4T} Z\left(\frac{j}{4}\right) Q\left(\frac{j}{4}\right)$$

where *Z(s)* is the risk-free discount factor for *s*-year maturity, and *Q(s)* is the risk-neutral survival probability over next *s* years. Assuming the flat term structure of survival probability, *Q(s)* can be simplified to $e^{-\lambda s}$ with the default intensity λ being equal to $4\,log\left(1 + \frac{CDS}{4L}\right)$, where CDS is the CDS spread and *L* is the loss given default (assumed to be fixed at 60%). This measure of excess CDS returns is commonly used in the literature; e.g., see Berndt and Obreja (2010), Bongaerts, De Jong, and Driessen (2011), and Bao and Pan (2013).

of 1.15% to 1.51% across different investment horizons.[15] Overall, these results corroborate our earlier findings that buying and selling bonds based on non-zero residual basis could generate significant positive trading profits.

[Insert Table 5 about Here]

4. Abnormal Returns of a Residual Basis Portfolio: Risk or Mispricing?

Although the residual basis may capture the temporary price misalignment (i.e., mispricing) of corporate bonds, we perform a more direct test to eliminate the alternative explanation that it may represent a missing systematic risk factor (e.g., Nashikkar, Subrahmanyam, and Mahanti, 2011). Following the standard approach in the literature (e.g., Fama and French, 1993; Daniel and Titman, 1997; Gebhardt, Hvidkjaer, and Swaminathan, 2005), we construct a factor-mimicking portfolio based on the residual basis and test its incremental explanatory power for corporate bond returns over traditional systematic risk factors.

4.1. The Construction of a Residual Basis Factor

We first sort investment-grade (IG) and high-yield (HY) bonds into three groups with low (L), medium (M), and high (H) levels of the residual basis on day *t*. Then we construct the factor-mimicking portfolio for the residual basis as the difference between the average value-weighted 20-day holding period returns of IG and HY bonds with the lowest residual basis (the L group) and for those with the highest residual basis (the H group) (from day *t* to day *t+20*), i.e., (IG/L+HY/L)/2–(IG/H+HY/H)/2. We name this portfolio the "LMH factor."

[Insert Table 6 about Here]

[15] These returns may be significant, assuming low transaction costs in the CDS market. In fact, Biswas, Nikolova, and Stahel (2015), who estimate and compare transaction costs for a bond and a CDS, show that bonds incur transaction costs that are more than *three* times those of the corresponding CDS.

Panel A in Table 6 reports summary statistics of the 20-day returns for the six systematic risk factors (*MKT*, *SMB*, *HML*, *DEF*, *TERM*, and *LIQ*), the LMH factor, and the six portfolios double-sorted by rating and the residual basis. The existing six systematic risk factors are defined in equation (7) and are used in Fama and French (1993) and Lin, Wang, and Wu (2011). Consistent with previous findings, for either the IG or HY category of bond portfolios, the lowest residual basis (the L group) have significantly higher returns than those with the highest residual basis (the H group). The LMH factor has the highest mean return (at 0.84) and the lowest standard deviation (1.06).

Panel B in Table 6 reports the correlation coefficients for all the pricing factors. It shows that the LMH factor is not highly correlated with the other six risk factors. The highest correlation is with the *TERM* factor at 0.20. Some of the other factors are significantly correlated with each other. For example, the correlation between the *DEF* factor and the *MKT* factor is 0.79. These results indicate that the LMH factor may expand the investment opportunity set offered by the existing risk factors. Indeed, Panel C of Table 6 shows that the Sharpe ratio improves substantially from 0.98 in the six-factor model to 1.42 once the LMH factor is included in the optimal portfolio mix.

4.2. Is the LMH Factor a Missing Systematic Risk Factor?

In order to know whether the LMH factor is a systematic risk factor for bond returns, it is necessary to determine whether the LMH factor has incremental explanatory power for corporate bond returns beyond the traditional bond pricing factors. To do so, we consider the following regressions of the value-weighed returns of the six double-sorted portfolios on credit ratings (IG and HY) and the residual basis (L, M, and H) (2×3):

$$HPR_{p,t,t+k} - r_{f,t,t+k} = \alpha_{p,k} + \beta_{1,p}MKT_{t,t+k} + \beta_{2,p}SMB_{t,t+k} + \beta_{3,p}HML_{t,t+k} + \beta_{4,p}DEF_{t,t+k} + \beta_{5,p}TERM_{t,t+k} + \beta_{6,p}LIQ_{t,t+k} + \varepsilon_{p,t} \quad (9)$$

$$HPR_{p,t,t+k} - r_{f,t,t+k} = \alpha_{p,k} + \beta_{1,p}MKT_{t,t+k} + \beta_{2,p}SMB_{t,t+k} + \beta_{3,p}HML_{t,t+k} + \beta_{4,p}DEF_{t,t+k} + \beta_{5,p}TERM_{t,t+k} + \beta_{6,p}LIQ_{t,t+k} + \beta_{7,p}LMH_{t,t+k} + \varepsilon_{p,t} \quad (10)$$

where $HPR_{p,t,t+k}$ is the *k*-day holding period return of bond portfolio *p* (where p = 6) formed on bond credit ratings and three basis groups from day *t* to $t+k$ (where k=20); the systematic risk factors are defined in equation (7). Panel A in Table 7 provides the results of the six-factor model in equation (9), and Panel B provides the results of the seven-factor model in equation (10).

[Insert Table 7 about Here]

The second and third columns of Panel A in Table 7 reveal a negative relation between the residual basis and portfolio excess returns for IG bonds. It also shows that we have larger return spreads between low and high residual basis portfolios than for HY bonds. The fourth column of Panel A reveals a negative relation between residual basis and portfolio abnormal returns: Portfolios with an extreme low (high) residual basis earn significant positive (negative) abnormal returns, while portfolios with a medium residual basis level (which is closer to zero) earn insignificant excess returns. Moreover, the intercepts are significantly different from zero, especially for IG portfolios under the six-factor model at the 1% significance level. These results suggest that the existing systematic risk factors do not capture the residual basis effect in the average returns.

Panel B of Table 7 reports the regression results of the seven-factor model, including the LMH factor. While three out of the six portfolios have significant loadings on the LMH factor at the 1% significance level and one at the 5% significance level, three out of the six portfolios have significant intercepts at the 1% significance level. Therefore, even though the LMH factor exhibits some co-variations with corporate bond returns, it still cannot completely explain the abnormal returns related to the residual basis.

To further explore whether the LMH factor can explain the return predictability of the residual basis, we apply the seven-factor asset pricing model to 18 triple-sorted bond portfolios, which are constructed based on credit rating (IG and HY), residual basis (L, M, and H), and factor loading on the LMH factor calculated using historical data 180 days prior to portfolio formation (L, M, and H) (i.e., 2×3×3). This approach is adapted from Daniel and Titman (1997). Columns two to four in Panel C of Table 7 show that the triple-sorting leads to portfolios with big variations in the loadings on the LMH factor after controlling for rating and residual basis. However, we do not find a positive relation or any clear pattern between the factor loadings on the LMH factor and the excess returns of the bond portfolios. This indicates that the LMH factor may not represent a missing systematic risk factor. Moreover, the LMH factor is significantly priced in only 11 out of 18 portfolios at the 10% significance level. While a satisfactory asset pricing model should predict zero intercepts for all portfolios, column six shows that 10 out of the 18 portfolios still have significant non-zero intercepts at the 1% significance level. These abnormal returns are economically significant and could be as high as 17.6 percent per annum. These results may suggest that the LMH factor cannot explain the abnormal returns of bond portfolios sorted by the residual basis.

4.3. Risk or Mispricing?

Given that the LMH factor does not explain the abnormal returns related to the residual basis, we run a horse-race between the LMH factor and the residual basis in the return regression as follows,

$$HPR_{i,t,t+k} - r_{f,t,t+k} = \alpha + \beta_1 Basis_{residual,i,t} + \beta_2 RATING_{i,t} + \beta_3 Coupon_{i,t}$$

$$+\beta_4 SIZE_{i,t} + \beta_5 Age_{i,t} + c_1\beta_{MKT,i,t} + c_2\beta_{SMB,i,t} + c_3\beta_{HML,i,t} + c_4\beta_{DEF,i,t}$$

$$+c_5\beta_{TERM,i,t} + c_6\beta_{LIQ,i,t} + c_7\beta_{FLIQ,i,t} + c_8\beta_{LMH,i,t} + \varepsilon_{p,t} \qquad (11)$$

where $HPR_{i,t,t+k}$ and $r_{f,t,t+k}$ are defined in the previous regressions; $Basis_{residual,i,t}$, $RATING_{i,t}$, $Coupon_{i,t}$, $Size_{i,t}$, and $Age_{i,t}$ are the residual basis level, credit rating, coupon rate, issue size, and age of individual bond *i* or bond portfolio *i* on day *t*, respectively; $\beta_{MKT,i,t}$, $\beta_{SMB,i,t}$, $\beta_{HML,i,t}$, $\beta_{DEF,i,t}$, $\beta_{TERM,i,t}$, $\beta_{LIQ,i,t}$, and $\beta_{FLIQ,i,t}$ are the beta loadings on the *MKT*, *SMB*, *HML*, *DEF*, *TERM*, *LIQ,* and *FLIQ* factors, respectively; and $\beta_{LMH,i,t}$ is the beta loading on the LMH factor. These betas are estimated from day *t–180* to day *t*. The factor *MKT*, *SMB*, *HML*, *DEF*, *TERM*, and *LIQ* are the same systematic risk factors defined in Fama and French (1993) and Lin, Wang, and Wu (2011). The factor *FLIQ* is the funding liquidity and is included to control for additional systematic risk arising from funding constraints (see, e.g., Brunnermeier and Pedersen, 2009). For individual bonds, we also include a liquidity factor (*Indliq*) that is the sum of the turnover of bond *i,* which is defined as the total trading volume divided by the total amount outstanding for the bond from day *t*–20 to day *t*. We run cross-sectional regressions on each day and report the time-series averages of the estimates of the coefficients in Table 8 (the Fama-Macbeth approach) for both bond portfolios and individual bonds. Robust Newey-West (1987) t-statistics of coefficients are reported in brackets.

[Insert Table 8 about Here]

Panel A in Table 8 reports the regression results of the 18 triple-sorted portfolios based on rating, residual basis, and loading on the LMH factor. Model 1 shows that the loading on the LMH factor is significantly positive at the 10% significance level (at 0.26), while Model 2 shows that the residual basis is negatively related to the returns with a coefficient of –0.54 at the 1% significance level. Model 3, which includes both the residual basis and the LMH loading in the same regression, shows that both coefficients are significantly negative at the 10% significance level. Model 4 includes the loadings of all the existing risk factors, and Model 5 includes all the bond characteristics as specified in equation (11). The coefficient of the residual basis remains significantly negative at the 1% significance level across all these models, whereas that of the LMH factor is not significant at the 10% level. These results suggest that the residual basis captures the mispricing in corporate bonds rather than a missing risk factor.

The results of five parallel models for individual bonds in Panel B of Table 8 are largely similar. They show that the coefficients of the residual basis are significantly negative at the 1% significance level, whereas the coefficients of the LMH factor are only marginally significant at the 5% or 10% significance level. In summary, our regression results provide consistent evidence that the abnormal returns of basis portfolios are more likely due to the mispricing of the bonds.

To provide further support for the mispricing interpretation of the abnormal returns from the residual basis portfolio, we examine whether the observed bonds with a highly negative residual basis may experience the convergence of the residual basis subsequently. If the residual basis is due to some missing systematic risk, the residual basis will not necessarily converge to zero. Figure 1 plots the time series of the residual basis for the quintile bond portfolio with the most negative residual basis. For each day, we construct the quintile portfolio based on the residual basis and track the subsequent movement of its residual basis for 300 trading days. We report the average of the residual basis from the formation date to 300 days after. It is shown that the residual basis starts around –60 bps and shrinks by half to –30 bps in one day. The residual basis continues to converge toward zero as time passes. Again, this result indicates that the residual basis is more closely related to mispricing than to an unknown risk factor.

[Insert Figure 1 about Here]

5. Robustness Tests

We perform several robustness tests in this section. First, we verify that the predictability of the basis is not driven by a market microstructure issue. Second, we verify that our results are robust for both investment- and speculative-grade bonds and CDS. Third, we confirm that our results are robust even during the recent financial crisis since the literature demonstrates that the credit markets can be disrupted by the limits to arbitrage. Last, we conduct robustness tests using alternative empirical measures for our main variables.

5.1. Microstructure Issue

There is potentially a market microstructure issue when we use the last transaction price of the day without knowing whether it is a bid price or an ask price.[16] Suppose the last transaction on day t is a trade at the bid price, which is a relatively low price (high yield spread); thus, when used to compute for the basis, it would have a relatively low (more negative) CDS-bond basis. As this bid price is also used in the computation of future bond returns or the change in CDS from day t to day $t+k$, this might create some upward bias in our prediction regression models. We therefore skip one trading day in constructing the future bond returns and the change in CDS by using the data from day $t+1$ to day $t+k+1$. We re-run Table 2 and Table 3 with the new measures and present the results in Table 9 for bond returns (Panel A) and CDS change (Panel B). While there is virtually no change in the results for CDS, the predictability of future bond returns is still statistically significant at the 1% significance level. In economic magnitude, the return predictability is smaller than that in Table 2. A one standard deviation decrease in $Basis_{residual}$ is related to an (annualized) excess return of 1.4% to 1.9% under Model 3.

[Insert Table 9 about Here]

[16] We thank the anonymous referee for raising this issue.

To confirm that our main result in Table 5 is still robust after taking into account the microstructure issue, we also verify that the negative basis trade is still profitable after skipping one trading day in measuring the returns and the change in CDS. The results are available in Appendix Table A.2.

5.2. Investment and Speculative Grade

Given that the literature has shown that investment-grade (IG) and high-yield bonds (HY) behave very differently in many dimensions, we perform a subsample analysis on these two groups of bonds separately. For example, Da and Gao (2010) find that the dominant investor clientele for IG and HY bonds are very different from each other. Acharya, Amihud, and Bharath (2013) also show that liquidity of the two types of bonds is very different. Moreover, there is anecdotal evidence that IG bonds are more widely used in basis arbitrage than HY bonds (Deutsche Bank, 2009; Asquith, Au, Covert, and Pathak, 2013). Table 10 reports the results of the subsample analysis of the predictability of the residual basis for future bond returns (Panel A) and CDS spreads (Panel B) in two separate subsamples.

[Insert Table 10 about Here]

Panel A in Table 10 shows that the coefficients of the residual basis are larger for IG bonds than for HY bonds on average (they range from –1.68 to –2.67 for IG bonds and from –0.87 to –1.65 for HY bonds). This implies that a decrease in $Basis_{residual}$ will lead to a higher return response in IG bonds than in HY bonds. All the other control variables are the same as those in Table 2. We also test whether the price convergence result is still consistent in the CDS leg. Panel B in Table 10 shows that the coefficients of the residual basis are statistically significant for both IG and HY CDS at the 1% significance level, except for the 60-day HY CDS. Like in the bond return regression, the coefficients of the residual basis are larger for IG CDS than for

HY CDS on average (they range from –2.34 to –5.33 for IG and from –1.07 to –1.75 for HY). A one standard deviation decrease in $Basis_{residual}$ can lead to about a 20% (12%) change in IG (HY) CDS spreads for the subsequent 20 trading days. The higher explanatory power in terms of both economic and statistical significance of the basis for investment-grade entities is consistent with the intuition that the investment-grade bonds are more widely used by the basis arbitrageurs.

5.3. Pre-crisis and Crisis Periods

Many studies have shown that the CDS-bond basis experienced dramatic disruption during the recent financial crisis (e.g., Duffie, 2010; Mitchell and Pulvino, 2012). The basis fell into a significantly negative range during the crisis. Table 11 reports the subsample analysis of the predictability of the residual and predicted basis for future bond returns and CDS spreads before and during the crisis. We split the sample into two periods, before the end of June 2007 and after June 2007, when the major U.S. brokerage firm Bear Stearns started to uncover significant losses in its high-grade credit funds.

[Insert Table 11 about Here]

Panel A of Table 11 reports the subsample analysis for corporate bond returns. We find that both the residual and the predicted basis have stronger predictive power for future bond returns before the financial crisis. The coefficients of $Basis_{residual}$ become smaller during the crisis period but remain significantly negative at the 1% significance level. The coefficients of $Basis_{predicted}$ not only decline during the crisis period but also become statistically insignificant when k gets larger (e.g., when k=40 and 60) at the 10% level. This result reveals again that $Basis_{residual}$ is superior to $Basis_{predicted}$ in capturing pure mispricing, since arbitrage force should lead to price convergence. The risky arbitrage interests (derived from $Basis_{predicted}$), on the other hand, may not always result in subsequent price convergence, plausibly because of a significant change in the underlying risk during the arbitraging period, which is from day t to $t+k$. Such a phenomenon is more likely to occur for a prolonged holding period (when k is bigger) and during the financial crisis.

Panel B of Table 11 reports the subsample analysis of CDS spreads. First, we find that the residual basis has the stronger predictive power for future CDS spreads before the financial crisis, whereas the predicted basis has almost zero predictability. Second, the predictive power of the residual basis disappeared almost completely during the financial crisis, especially for longer holding horizons. The predicted basis, on the contrary, predicted the positive movement in CDS spread, implying price divergence in the CDS market. These results are consistent with the anecdotal evidence that the CDS market was greatly disrupted during the financial crisis.

We also perform other robustness tests and report these results in the appendix. For example, we report the subsample results for both investment- and speculative-grade credit products for pre-crisis and crisis periods in Appendix Table A.3. We also re-run all the subsample analyses after taking into account the microstructure issues in Appendix Tables A.4, A.5, and A.6. Last, we use different empirical proxies for liquidity risk in Appendix Table A.7. Our main results in Tables 2, 3, and 5 remain robust.

In summary, we find that the residual basis strongly predicts price convergence between the corporate bond and CDS markets. At the same time, while the predicted basis predicts future bond returns, it has no impact on future CDS changes. These results are consistent with the interpretation that the residual basis is a better measure of pure arbitrage opportunity, which predicts price convergence between the two markets. This finding suggest that CDS improve the efficiency of the corporate bond market through the arbitrage channel. We also find that basis arbitrage works better for CDS of IG firms in normal market conditions when the limits to arbitrage are less binding.

6. Conclusion

In this study we document a strong relation between the CDS-bond basis and future bond returns. We find that the residual basis, the part of the CDS-bond basis that cannot be explained by a wide range of known risk factors, captures mispricing between CDS and corporate bonds. Arbitrageurs could achieve significant abnormal returns by buying (shorting) bonds with a low (high) residual basis after controlling for a wide range of systematic factors and bond characteristics. The residual basis strongly predicts price convergence between corporate bonds and CDS, with price adjustments mainly occurring in bond markets. These results suggest that the existence of CDS may help bring the prices of corporate bonds closer to their fundamental values.

Our study contributes to the current debate over the economic benefits and costs of CDS by providing robust empirical evidence that CDS may help improve the efficiency of the corporate bond market through the classical arbitrage channel between derivatives and the underlying market. The introduction of CDS brings significant benefits to the corporate bond market: (i) by providing an information advantage, CDS make it much easier to identify mispriced bonds; and (ii) in their insurance role, CDS reduce the risk of arbitrage by removing the default risk.

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Figure 1. Time Series of Residual Basis for the Most Negative Basis Bonds

This graph plots the time series of the observed residual basis for highly negative basis bonds. On date 0, we construct a portfolio of bonds with a highly negative CDS-bond residual basis and compute the portfolio's residual basis for days subsequent to date 0. Number of days represents the time difference in days between the portfolio formation date (date 0) and the date on which the portfolio basis is observed.

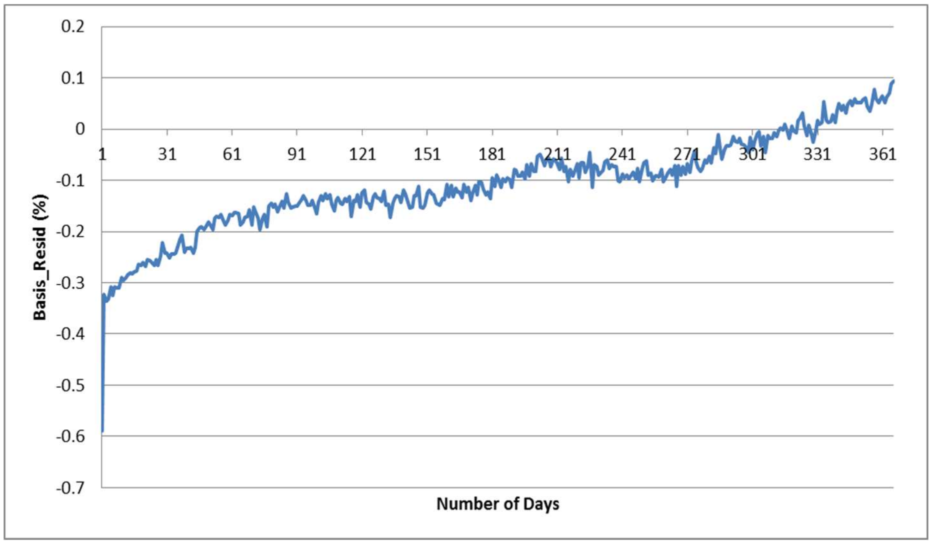

Table 1. Summary Statistics

This table provides summary statistics about the sample firms and bonds used in the analysis from 2003 through 2008. Panel A reports the yearly breakdown of the number of firms and bonds for investment-grade and high-yield bonds. Panel B reports summary statistics for the key variables. Panel C reports the correlation coefficient matrix of these variables with the statistically significant numbers in gray. *Basis* is defined as (CDS spread – Z-spread) on day *t* for the individual bond. $Basis_{predicted}$ is the predicted component of *Basis* by the model in Bai and Collin-Dufresne (2014), and $Basis_{residual}$ is computed as ($Basis - Basis_{predicted}$). *Bond Return* is the individual bond's 20-day excess return from day *t–20* to day *t*. *CDS Spread* is the CDS spread on day *t* and *Δ(CDS Spread)* is the rate of CDS spread changes from day *t–20* to day *t*. *Rating* is a categorical variable ranging from 1 to 20 for all bonds (S&P rating AAA to CC). We use the S&P ratings whenever available, followed by Moody's and Fitch's ratings. *Coupon* is in percentage terms. *Issue size* is the natural logarithm of the issuance amount in billions. *Maturity* and *age* are in years. *Indliq* is the 20-day cumulative turnover measured as the total trading volume divided by the total number outstanding. *Δ(CDSliq)* is the 20-day change in the number of CDS dealers' quotes. *Stock return* is the rate of changes in stock prices within the past one month. *Δ(Volatility)* is the rate of change in stock volatility within the past one month, where stock volatility is defined as the standard deviation of daily stock returns measured in a 60-day window. *Δ(Leverage)* is the rate of change in market leverage within the past three months, where market leverage is measured by the book value of total debt divided by the market value of total assets. *Δ(Size)* is the rate of change in the logarithm of the market value of total assets within the past three months. *Δ(Profitability)* is the rate of change in net income divided by the market value of total assets within the past three months. *Δ(Cash)* is defined as the rate of change in the cash ratio in the past three months. The cash ratio is defined as the ratio of cash and cash equivalent divided by the market value of total assets.

Panel A: Yearly Breakdown of the Number of Firms and Bonds

	2003	2004	2005	2006	2007	2008	Total
Investment Grade							
FIRM	92	133	148	146	123	123	765
BOND	303	472	534	492	424	390	2,615
Obs.	14,086	23,180	33,059	29,017	21,600	20,543	141,485
Speculative Grade							
FIRM		32	47	57	50	43	229
BOND		75	136	139	95	94	539
Obs.		1,861	11,354	12,992	7,174	6,226	39,607

Panel B: Summary Statistics

	N	MEAN	STD	MIN	MAX
Basis (%)	181,092	-0.05	1.02	-3.30	8.28
$Basis_{predicted}$	181,092	-0.05	0.84	-4.16	8.44
$Basis_{residual}$	181,092	0.00	0.58	-6.77	6.12
Investment Grade					
Basis	141,485	-0.30	0.55	-3.30	0.98
$Basis_{predicted}$	141,485	-0.30	0.40	-3.56	3.37
$Basis_{residual}$	141,485	0.00	0.39	-3.00	2.96
Speculative Grade					
Basis	39,607	0.81	1.66	-3.30	8.28
$Basis_{predicted}$	39,607	0.81	1.32	-4.16	8.44
$Basis_{residual}$	39,607	0.00	1.01	-6.77	6.12
Bond Return (%)	181,092	0.03	2.63	-9.51	8.40
CDS Spread (%)	181,092	1.53	2.81	0.02	55.65
Δ(CDS Spread) (%)	181,092	1.83	20.68	-39.22	89.85
Rating	181,092	8.59	3.61	1.00	20.00
Maturity	181,092	9.08	7.66	1.04	29.94
Issue Size	181,092	12.88	0.58	10.82	14.51
Age	181,092	5.72	4.09	0.05	26.06
Coupon	181,092	6.57	1.42	1.95	11.25
Indliq	181,028	0.05	0.06	0.00	1.16
$\Delta(CDS_{liq})$	180,850	0.00	0.32	-1.95	1.79
Stock Return (%)	176,465	0.24	9.27	-75.58	172.48
Δ(Volatility)	176,871	0.10	0.47	-0.96	6.32
Δ(Leverage)	178,955	0.02	0.84	-0.93	191.99
Δ(Size) (%)	178,956	0.08	1.32	-12.21	11.37
Δ(Profitability)	176,580	0.40	7.58	-98.94	216.70
Δ(Cash)	178,618	0.30	2.48	-1.00	120.46

Panel C: Correlation Coefficients

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
(1)	**Basis**	1.00																	
(2)	**Basis$_{predicted}$**	0.82	1.00																
(3)	**Basis$_{residual}$**	0.57	0.00	1.00															
(4)	**Bond Return**	0.10	0.02	0.16	1.00														
(5)	**CDS Spread**	0.69	0.70	0.19	-0.11	1.00													
(6)	**Δ(CDS Spread)**	-0.01	-0.03	0.03	-0.22	0.09	1.00												
(7)	**Rating**	0.44	0.54	0.00	0.00	0.67	-0.01	1.00											
(8)	**Maturity**	-0.08	-0.01	-0.12	-0.01	0.09	0.02	0.04	1.00										
(9)	**Age**	0.07	0.10	-0.03	0.00	0.16	0.00	0.09	0.09	1.00									
(10)	**Coupon**	0.17	0.30	-0.14	0.02	0.39	-0.02	0.47	0.19	0.51	1.00								
(11)	**Issue Size**	-0.05	-0.08	0.04	-0.01	-0.05	0.03	-0.06	0.05	-0.38	-0.07	1.00							
(12)	**Indliq**	0.16	0.15	0.06	0.05	0.15	0.01	0.17	0.05	-0.26	-0.01	0.09	1.00						
(13)	**Δ(CDS$_{liq}$)**	0.00	0.00	0.00	0.02	-0.02	0.04	-0.02	0.00	-0.01	-0.01	-0.01	0.02	1.00					
(14)	**Stock Return**	0.07	0.09	-0.01	0.28	-0.07	-0.30	0.02	-0.01	-0.01	0.04	-0.03	0.07	0.00	1.00				
(15)	**Δ(Volatility)**	-0.03	-0.03	0.00	-0.06	0.05	0.13	0.01	0.00	0.00	-0.01	0.01	0.04	0.00	-0.05	1.00			
(16)	**Δ(Leverage)**	-0.01	0.00	-0.01	0.00	0.01	0.01	0.00	0.00	-0.01	-0.01	0.00	0.01	0.00	-0.01	0.01	1.00		
(17)	**Δ(Size)**	0.01	0.03	-0.02	0.02	-0.09	-0.06	0.00	-0.01	-0.02	0.03	-0.04	-0.01	0.01	0.05	-0.02	-0.06	1.00	
(18)	**Δ(Profitability)**	-0.04	-0.03	-0.03	-0.03	0.00	0.03	-0.01	0.02	0.00	-0.01	0.02	-0.04	-0.01	-0.02	0.03	0.00	0.00	1.00
(19)	**Δ(Cash)**	-0.02	0.00	-0.03	-0.01	-0.01	-0.01	0.01	0.01	-0.02	0.02	0.03	0.01	0.00	0.00	0.01	0.02	-0.07	0.01

Table 2. Predictive Power of Basis for Future Bond Returns

This table reports the predictive power of residual and predicted basis for future bond excess returns from 2003 through 2008. Average daily coefficients and t-statistics are reported for Fama-Macbeth (1973) regressions for individual bond's excess returns for k days (k= 20, 40, and 60). The dependent variable is the individual bond's *k*-day excess return from day *t* to day *t+k*. *Basis* is defined as (CDS spread – Z-spread) on day *t* for the individual bond. $Basis_{predicted}$ is the predicted component of *Basis* by the model in Bai and Collin-Dufresne (2014) and $Basis_{residual}$ is defined as ($Basis - Basis_{predicted}$). *Bond Return* is the individual bond's lagged 20-day excess return from day *t–k* to day *t*. *CDS Spread* is the CDS spread on day *t* and *Δ(CDS Spread)* is the rate of CDS spread changes from day *t–k* to day *t*. *Rating* is a categorical variable ranging from 1 to 20 for all bonds (S&P rating AAA to CC). We use the S&P ratings whenever available, followed by Moody's and Fitch's ratings. *Coupon* is in percentage terms. *Issue size* is the natural logarithm of the issuance amount in billions. *Maturity* and *age* are in years. *Indliq* is the *k*-day cumulative turnover measured as the total trading volume divided by the total number outstanding. The Newey-West t-statistics are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Dependent Variabe: Future Bond Return								
	k=20			k=40			k=60		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
$Basis_{residual}$	-1.67***	-1.68***	-1.23***	-1.88***	-1.89***	-1.47***	-2.03***	-2.04***	-1.71***
	[-26.35]	[-26.57]	[-23.36]	[-19.46]	[-19.63]	[-15.27]	[-14.35]	[-14.34]	[-12.20]
$Basis_{predicted}$	-1.38***	-1.39***	-0.98***	-1.51***	-1.52***	-1.17***	-1.52***	-1.53***	-1.26***
	[-12.82]	[-13.06]	[-9.81]	[-7.93]	[-8.06]	[-6.45]	[-5.42]	[-5.57]	[-4.84]
CDS Spread	0.42***	0.42***	0.33***	0.48***	0.49***	0.41***	0.55***	0.55***	0.50***
	[6.33]	[6.40]	[5.09]	[3.84]	[3.92]	[3.13]	[2.99]	[3.14]	[2.66]
Δ(CDS Spread)		-0.00***			-0.00**			-0.00**	
		[-3.01]			[-2.03]			[-1.97]	
Bond Return			-0.26***			-0.22***			-0.16***
			[-23.32]			[-10.72]			[-5.49]
Rating	-0.12***	-0.12***	-0.09***	-0.15***	-0.15***	-0.11***	-0.15***	-0.16***	-0.12**
	[-6.12]	[-6.19]	[-4.59]	[-3.73]	[-3.82]	[-3.00]	[-2.93]	[-3.06]	[-2.33]
Maturity	-0.03***	-0.03***	-0.03***	-0.05***	-0.05***	-0.04**	-0.07***	-0.06***	-0.06**
	[-3.87]	[-3.93]	[-2.72]	[-2.93]	[-2.87]	[-2.32]	[-2.69]	[-2.62]	[-2.43]
Age	0.00	0.00	0.00	-0.01	-0.01	0.00	-0.02	-0.02	-0.01
	[-0.59]	[-0.46]	[-0.32]	[-0.65]	[-0.69]	[-0.35]	[-0.87]	[-0.96]	[-0.69]
Coupon	-0.12***	-0.12***	-0.08***	-0.11***	-0.11***	-0.08***	-0.10**	-0.09**	-0.08**
	[-6.97]	[-7.04]	[-4.71]	[-3.93]	[-3.87]	[-2.76]	[-2.54]	[-2.28]	[-2.03]
Issue Size	0.07***	0.08***	0.04	0.10**	0.10**	0.07	0.09	0.09	0.07
	[2.77]	[3.09]	[1.56]	[1.96]	[2.00]	[1.33]	[1.41]	[1.36]	[1.07]
Indliq	0.22	0.25	0.39	-0.04	-0.01	0.08	-0.31	-0.29	-0.25
	[0.54]	[0.60]	[0.94]	[-0.10]	[-0.02]	[0.19]	[-0.83]	[-0.76]	[-0.68]
N	181,028	181,028	181,028	172,320	172,320	172,320	163,329	163,329	163,329
R^2	0.31	0.31	0.37	0.41	0.41	0.45	0.46	0.47	0.50

Table 3. Predictive Power of Basis for Change in Future CDS Spreads

This table reports the predictive power of residual and predicted basis for the rate of change in future individual CDS spreads from 2003 through 2008. We run Fama-Macbeth (1973) regressions on the change in CDS for the next *k* days (k=20, 40, and 60). The dependent variable is the rate of CDS spread changes from day *t* to day *t+k*. *Basis* is defined as (CDS spread – Z-spread) on day *t* for the individual bond. $Basis_{predicted}$ is the predicted component of *Basis* by the model in Bai and Collin-Dufresne (2014), and $Basis_{residual}$ is computed as ($Basis - Basis_{predicted}$). *Bond Return* is the individual bond's *k*-day excess return from day *t–k* to day *t*. *CDS Spread* is the CDS spread on day *t* and *Δ(CDS Spread)* is the rate of CDS spread changes from day *t–k* to day *t*. *Δ(CDSliq)* is the *k*-day change in the number of CDS dealers' quotes. *Stock return* is the rate of changes in stock prices within the past one month. *Δ(Volatility)* is the rate of change in stock volatility within the past one month, where stock volatility is defined as the standard deviation of daily stock returns measured in a 60-day window. *Δ(Leverage)* is the rate of change in market leverage within the past three months, where market leverage is measured by the book value of total debt divided by the market value of total assets. *Δ(Size)* is the rate of change in the logarithm of the market value of total assets within the past three months. *Δ(Profitability)* is the rate of change in net income divided by the market value of total assets within the past three months. *Δ(Cash)* is defined as the rate of change in cash ratio in the past three months. The cash ratio is defined as the ratio of cash and cash equivalent divided by the market value of total assets. The Newey-West t-statistics are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Dependent Variabe: Future ΔCDS								
	k=20			k=40			k=60		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
$Basis_{residual}$	-2.10***	-2.07***	-2.32***	-3.49***	-3.27***	-3.80***	-4.45***	-4.11***	-4.24***
	[-7.39]	[-7.04]	[-7.51]	[-5.26]	[-4.59]	[-5.77]	[-4.01]	[-3.33]	[-3.90]
$Basis_{predicted}$	-0.34	-0.12	-0.52	0.65	0.93	0.29	1.47	1.40	1.20
	[-0.44]	[-0.15]	[-0.68]	[0.34]	[0.50]	[0.16]	[0.45]	[0.43]	[0.38]
CDS Spread	-1.82***	-1.54**	-1.93***	-3.38***	-3.07**	-3.80***	-4.67**	-4.45**	-5.43***
	[-2.84]	[-2.40]	[-2.90]	[-2.72]	[-2.49]	[-2.85]	[-2.51]	[-2.24]	[-2.72]
Δ(CDS Spread)		-0.10***			-0.09***			-0.11***	
		[-5.83]			[-4.01]			[-3.81]	
Bond Return			0.23***			0.47***			0.44**
			[4.33]			[4.40]			[2.09]
Δ(CDSliq)	0.53	0.61	0.51	-0.72	-0.41	-0.73	-2.01**	-1.24	-1.93**
	[1.17]	[1.37]	[1.14]	[-1.10]	[-0.67]	[-1.12]	[-2.04]	[-1.22]	[-2.01]
Stock Return	-0.22***	-0.25***	-0.23***	-0.23***	-0.28***	-0.24***	-0.24***	-0.29***	-0.25***
	[-7.16]	[-8.13]	[-7.40]	[-4.51]	[-5.60]	[-4.83]	[-3.95]	[-5.02]	[-4.40]
Δ(Volatility)	0.94*	0.94*	0.97*	0.65	1.05	0.68	0.74	0.96	0.70
	[1.88]	[1.94]	[1.94]	[0.85]	[1.34]	[0.88]	[0.65]	[0.87]	[0.61]
Δ(Leverage)	2.73	2.77	2.80	1.55	2.21	1.69	-0.24	0.77	0.27
	[1.39]	[1.41]	[1.41]	[0.52]	[0.74]	[0.57]	[-0.06]	[0.18]	[0.06]
Δ(Size)	-0.65***	-0.66***	-0.68***	-1.64***	-1.69***	-1.67***	-2.39***	-2.66***	-2.40***
	[-2.66]	[-2.63]	[-2.79]	[-3.52]	[-3.61]	[-3.54]	[-3.26]	[-3.48]	[-3.23]
Δ(Profitability)	0.16	0.26	0.17	0.19	0.35	0.25	-0.08	0.01	0.00
	[0.71]	[1.17]	[0.78]	[0.45]	[0.84]	[0.59]	[-0.16]	[0.01]	[-0.01]
Δ(Cash)	-0.06	-0.08	-0.07	-0.7	-0.74	-0.74	-1.31	-1.27	-1.31
	[-0.24]	[-0.31]	[-0.28]	[-1.32]	[-1.39]	[-1.40]	[-1.52]	[-1.42]	[-1.49]
N	176,580	176,580	176,580	168,133	168,133	168,133	159,445	159,445	159,445
R^2	0.14	0.18	0.14	0.15	0.19	0.16	0.17	0.20	0.18

Table 4. Abnormal Returns Based on Residual and Predicted Basis

This table reports the average abnormal returns of basis quintile corporate bond portfolios sorted by residual and predicted basis. For each day, basis portfolios are divided into quintiles by sorting the bonds based on the residual and predicted basis, and their returns are computed as value-weighted average returns for the next 20 days. Residual basis is the difference between the basis and the predicted component of basis by the model in Bai and Collin-Dufresne (2014). Basis is defined as the difference between the CDS spread and Z-spread. "Low-High" indicates the returns of zero-investment portfolios constructed by longing the lowest basis quintile portfolio and shorting the highest basis quintile portfolio. Basis quintile portfolios are also constructed by year and several bond characteristics such as rating, maturity, age, coupon, and issue size. Bonds are first divided by each characteristic (or year) and then sorted into quintiles based on the residual and predicted basis within each characteristic (or year) group. Rating groups 1 to 4 are defined for investment-grade bonds with S&P rating AAA, AA, and A to BBB, respectively, and groups 5 to 7 for high-yield bonds with rating BB, B to CCC, and below, respectively. Maturity groups 1 to 5 are defined for bonds with 1–3 years, 3–5 years, 5–7 years, 7–10 years, and more than 10 years to maturity, respectively. Age groups 1 to 5 are defined for bonds that are less than 3 years, 3–5 years, 5–7 years, 7–10 years, and more than 10 years old. Coupon groups 1 to 5 represent bonds with an annual coupon of 0–5.5, 5.5–6.5, 6.5–7, 7–8, and more than 9 percent. Issue size groups 1 to 5 represent bonds with an issuance amount of 0–0.2, 0.2–0.3, 0.3–0.5, 0.5–0.6, and more than \$0.6 billion. Bonds are sorted on the residual basis ($Basis_{residual}$) in Panel A and the predicted basis ($Basis_{predicted}$) in Panel B. *Basis* is defined as (CDS spread – Z-spread) for the individual bond. $Basis_{predicted}$ is the predicted component of *Basis* by the model in Bai and Collin-Dufresne (2014), and $Basis_{residual}$ is computed as ($Basis$ – $Basis_{predicted}$). ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Residual Basis as Trading Signal

		Returns					
		Low	2	3	4	High	Low-High
All Firms		1.58***	0.96***	0.61***	0.29***	-0.21**	1.79***
Year	2003	1.98***	0.65***	0.62***	0.24*	-0.19	2.17***
	2004	1.71***	0.94***	0.61***	0.24***	-0.04	1.76***
	2005	1.22***	0.93***	0.54***	0.26**	-0.29	1.51***
	2006	1.76***	1.86***	1.26***	0.89***	0.95***	0.80***
	2007	2.27***	1.76***	1.46***	1.05***	0.38***	1.89***
	2008	1.48***	0.81***	0.28**	-0.12	-0.67**	2.15***
Rating	1	1.64***	1.07***	0.25***	0.01	-0.11	1.75***
	2	1.26***	0.77***	0.41***	0.17**	-0.16**	1.42***
	3	1.93***	1.07***	0.69***	0.40***	-0.16**	2.10***
	4	1.88***	0.97***	0.72***	0.33***	-0.33**	2.22***
	5	0.40	0.10	-0.02	0.10	-0.50	0.90***
	6	1.05***	0.61**	0.44**	0.12	-0.43	1.48***
	7	1.25***	0.20	-0.56	-0.55	-0.29	1.54***
Maturity	1	1.03***	0.36***	0.15***	-0.06	-0.32**	1.35***
	2	1.17***	0.62***	0.36***	0.20***	-0.28**	1.45***
	3	1.43***	0.85***	0.55***	0.43***	-0.07	1.50***
	4	1.51***	1.19***	0.81***	0.55***	0.08	1.43***
	5	2.09***	1.59***	1.02***	0.63***	0.03	2.06***
Age	1	1.50***	1.15***	0.73***	0.34***	-0.19**	1.69***
	2	1.55***	0.85***	0.47***	0.31***	-0.01	1.57***
	3	1.58***	0.97***	0.53***	0.28***	-0.27**	1.85***
	4	1.57***	0.96***	0.38***	0.01	-0.42**	1.99***
	5	1.74***	1.14***	0.63***	0.26*	-0.48**	2.22***
Coupon	1	1.42***	0.87***	0.59***	0.33***	-0.20**	1.61***
	2	1.70***	1.00***	0.66***	0.36***	-0.23**	1.93***
	3	1.79***	1.09***	0.75***	0.34***	-0.19**	1.97***
	4	1.58***	1.04***	0.52***	0.18**	-0.28**	1.86***
	5	1.53***	0.74***	0.45***	-0.08	-0.24	1.77***
Issue Size	1	1.50***	0.68***	0.26*	-0.24	-0.71**	2.20***
	2	1.83***	1.10***	0.58***	0.08	-0.30**	2.13***
	3	1.51***	0.91***	0.55***	0.30***	-0.17*	1.67***
	4	1.21***	0.71***	0.44***	0.23***	-0.22*	1.43***
	5	1.62***	1.11***	0.77***	0.43***	-0.10	1.72***

Panel B: Predicted Basis as Trading Signal

		Returns					
		Low	2	3	4	High	Low-High
All Firms		0.89***	0.78***	0.70***	0.55***	0.22*	0.67***
Year	2003	0.93***	0.74***	0.66***	0.67***	0.38***	0.55***
	2004	0.85***	0.79***	0.75***	0.61***	0.46***	0.39***
	2005	0.70***	0.65***	0.70***	0.55***	-0.08	0.78**
	2006	1.36***	1.44***	1.40***	1.09***	1.38***	-0.01
	2007	1.68***	1.53***	1.52***	1.32***	0.57**	1.11***
	2008	0.60***	0.34**	0.30*	0.19	0.28	0.32
Rating	1	0.48***	0.52***	0.33***	0.71***	0.75***	-0.26
	2	0.40***	0.42***	0.39***	0.54***	0.58***	-0.19**
	3	0.95***	0.89***	0.79***	0.72***	0.60***	0.35***
	4	1.06***	0.72***	0.70***	0.54***	0.34**	0.73***
	5	0.25	0.18	0.10	-0.10	-0.35	0.60*
	6	0.50**	0.53**	0.53**	0.34	0.09	0.41
	7	-0.26	-0.26	0.04	0.33	-0.12	-0.14
Maturity	1	0.44***	0.24***	0.15***	0.08	0.08	0.36***
	2	0.69***	0.46***	0.39***	0.29***	0.13	0.56***
	3	0.80***	0.75***	0.64***	0.55***	0.16	0.64***
	4	0.97***	0.95***	0.85***	0.74***	0.52***	0.45***
	5	1.30***	1.25***	1.19***	1.00***	0.26	1.05***
Age	1	0.98***	0.83***	0.82***	0.66***	0.39***	0.59***
	2	0.86***	0.72***	0.64***	0.44***	0.34**	0.52***
	3	0.88***	0.69***	0.68***	0.53***	0.22	0.66***
	4	0.77***	0.59***	0.59***	0.25***	0.09	0.69***
	5	0.85***	0.94***	0.88***	0.45***	-0.13	0.98***
Coupon	1	0.85***	0.64***	0.55***	0.44***	0.44***	0.40***
	2	0.85***	0.71***	0.73***	0.60***	0.49***	0.36***
	3	1.04***	0.81***	0.74***	0.62***	0.24*	0.81***
	4	0.71***	0.71***	0.76***	0.51***	0.06	0.65***
	5	0.66***	0.70***	0.59***	0.19	-0.13	0.78***
Issue Size	1	0.62**	0.52***	0.35**	0.09	-0.13	0.75***
	2	0.78***	0.93***	0.69***	0.56***	0.12	0.66***
	3	0.89***	0.69***	0.68***	0.49***	0.31*	0.58***
	4	0.68***	0.68***	0.53***	0.36***	-0.01	0.70***
	5	0.94***	0.89***	0.82***	0.65***	0.51***	0.43***

Table 5. Excess Returns of a Negative Basis Trade

This table presents the excess returns of a strategy of buying negative CDS-bond basis bonds and buying insurance through CDS for the *k*-day holding period (*k*=20, 40, and 60). On day *t*, we form the quintile portfolio based on bond's residual basis and measure the excess returns on both bond and CDS from day *t* to *t*+*k*. Only the results for the highest negative quintile are reported. Residual basis is the difference between the basis and the predicted component of basis by the model in Bai and Collin-Dufresne (2014). Basis is defined as the difference between the CDS spread and Z-spread. Realized excess bond returns are computed as the bond's HPR, defined in equation (3), in excess of risk-free rates. Realized excess CDS returns are approximated using the difference in CDS spreads between day *t* and *t*+*k,* multiplied by the value of a defaultable T-year annuity where T is the CDS maturity. Number of bonds is the number of bonds included in the portfolio. For each bond, there is a corresponding CDS. The Newey-West t-statistics are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

k	Residual Basis (%)	Excess Return (%)		Number of Bonds	Observations
		Bond	CDS		
20	-0.71	0.92***	0.19***	30	1,204
		[16.70]	[5.77]		
40	-0.68	0.94***	0.37***	29	1,192
		[10.41]	[7.10]		
60	-0.64	0.83***	0.64***	27	1,174
		[7.76]	[9.45]		

Table 6. Summary Statistics of Bond Market Factors

This table provides summary statistics for our residual basis factor (LMH) as well as well-known systematic risk factors for the corporate bond market. Basis factor is constructed using double-sorted bond portfolios: bonds are independently sorted by credit rating and residual basis. Residual basis is the difference between the basis (which is the difference between CDS spread and Z-spread) and the predicted basis using the model in Bai and Collin-Dufresne (2014). We divide bonds into two rating groups, investment grade (IG) and high yield (HY). Bonds are also grouped into three basis portfolios (L, M, or H) based on the residual basis. Six portfolios (IG/L, IG/M, IG/H, HY/L, HY/M, HY/H) are formed as the intersections of the two rating groups and three basis groups. The basis factor, LMH (Low minus High), is defined as the return differential between low residual basis portfolio and high residual basis portfolio, i.e., (IG/L+HY/L)/2 – (IG/H+HY/H)/2. *MKT*, *SMB*, and *HML* are the Fama-French (1993) three factors. *TERM* is the difference between the daily return of the 10-year-to-maturity government bond index and the daily T-bill return. *DEF* is the difference between the daily return of the Lehman investment-grade bond index and the daily 10-year-to-maturity government bond from CRSP. *LIQ* is the Amihud (2002) bond market liquidity risk factor. We report the summary statistics on factor returns in Panel A and their correlations in Panel B. Panel C reports the ex post Sharpe Ratio.

Panel A: Mean and Standard Deviations of Factor Returns

								Rating/Basis					
	R_M-R_F	SMB	HML	DEF	TERM	LIQ	LMH	IG/L	IG/M	IG/H	HY/L	HY/M	HY/H
Avg.	-0.41	-0.01	0.30	-0.63	-1.89	-0.09	0.84	0.42	-0.13	-0.61	0.05	-0.44	-0.59
Std. dev.	4.94	2.06	2.10	2.53	2.94	1.32	1.06	1.67	1.44	1.16	2.59	2.54	2.87
t(Avg.)	-2.39	-0.11	4.08	-7.09	-18.40	-2.06	22.48	7.27	-2.59	-14.98	0.51	-4.98	-5.93

Panel B: Corleation Among Factors

	LMH	MKT	SMB	HML	DEF	TERM	LIQ
LMH	1.00						
MKT	0.14***	1					
SMB	0.04	0.42***	1				
HML	-0.08**	0.18***	0.26***	1			
DEF	0.11***	0.79***	0.28***	0.03	1		
TERM	0.20***	-0.17***	-0.08**	-0.13***	-0.27***	1	
LIQ	0.02	0.57***	0.26***	0.16***	0.57***	0.07**	1

Panel C: Ex post Sharpe Ratio

Portfolio weights							Ex post tangency portfolio		
MKT	SMB	HML	DEF	TERM	LIQ	LMH	Avg.	Std. Dev.	Sharpe ratio
1.00							0.40	2.95	0.15
0.29	0.00	0.71					0.43	1.46	0.29
0.28	0.04	0.68	0.00	0.00			0.42	1.42	0.29
0.00	0.00	0.02	0.00	0.00	0.98		0.80	0.81	0.98
0.00	0.00	0.02	0.00	0.00	0.47	0.51	0.80	0.56	1.42

Table 7. Residual Basis Factor LMH as a Systematic Risk Factor

The table reports time-series regressions for the returns of basis portfolios on existing systematic risk factors for corporate bonds. The six portfolios are double-sorted by two credit rating groups (IG for investment-grade bonds and HY for high-yield bonds) (*rating*) and three residual basis groups (L for low, M for medium, H for high) ($Basis_{residual}$). The value-weighted average returns for the next 20 days are computed for each portfolio (*Eret*). *MKT*, *SMB*, and *HML* are the Fama-French (1993) three factors and *TERM* is the difference between the daily return of the 10-year-to-maturity government bond index and the daily T-bill return. *DEF* is the difference between the daily return of the Lehman investment-grade bond index from Datastream and the daily 10-year-to-maturity government bond return from CRSP. *LIQ* is the market liquidity risk factor in Amihud (2002). Panel A reports the regression results for the six-factor model and Panel B reports the results for a seven-factor model with the basis factor *LMH* added. In Panel C, each of the six portfolios is further divided into three portfolios (L, M, and H) based on preformation LMH loading estimated over the past 180 days (*Loading*). The regression results with 18 triple-sorted portfolios are reported in Panel C. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Six-Factor Model Double-Sorted Portfolios on Rating and Basis

Rating/Basis	Rating	$Basis_{residual}$	Eret	Intercept	MKT	SMB	HML	DEF	TERM	LIQ	R^2
IG/L	7.81	-0.41	0.42	1.50***	0.04**	-0.01	0.01	0.39***	0.43***	0.00	0.78
				[9.97]	[1.99]	[-0.41]	[0.30]	[8.1]	[8.51]	[0.09]	
IG/M	7.45	0.02	-0.13	0.77***	0.03	-0.01	0.01	0.32***	0.36***	0.11**	0.69
				[7.86]	[1.61]	[-0.36]	[0.26]	[7.14]	[12.8]	[2.04]	
IG/H	6.95	0.38	-0.61	0.04	0.02	0.00	0.03	0.23***	0.26***	0.14**	0.60
				[0.41]	[1.23]	[-0.01]	[1.21]	[5.63]	[9.68]	[2.36]	
HY/L	13.94	-0.98	0.05	0.34	0.25***	0.06	0.21***	0.38***	0.01	-0.11	0.67
				[1.6]	[5.44]	[1.05]	[3.09]	[5.16]	[0.18]	[-0.83]	
HY/M	13.88	-0.38	-0.44	-0.21	0.17***	0.07	0.12**	0.45***	-0.05	0.02	0.56
				[-0.97]	[3.13]	[1.06]	[2.03]	[5.72]	[-0.64]	[0.17]	
HY/H	14.25	0.78	-0.59	-0.36	0.19***	0.04	0.23**	0.41***	-0.02	0.04	0.67
				[-1.38]	[3.14]	[0.37]	[2.09]	[3.15]	[-0.30]	[0.34]	

Panel B: Seven-Factor Model for Double-Sorted Portfolios on Rating and Basis

Rating/Basis	Rating	$Basis_{residual}$	Eret	Intercept	MKT	SMB	HML	DEF	TERM	LIQ	LMH	R^2
IG/L	7.81	-0.41	0.42	1.36***	0.03	-0.01	0.01	0.38***	0.42***	0.02	0.14**	0.79
				[7.63]	[1.62]	[-0.43]	[0.41]	[7.98]	[8.21]	[0.47]	[2.36]	
IG/M	7.45	0.02	-0.13	0.80***	0.03	-0.01	0.01	0.32***	0.36***	0.11**	-0.02	0.69
				[7.06]	[1.64]	[-0.36]	[0.23]	[7.30]	[12.1]	[2.02]	[-0.60]	
IG/H	6.95	0.38	-0.61	0.15	0.03	0.00	0.03	0.24***	0.27***	0.13**	-0.10***	0.61
				[1.47]	[1.45]	[0.00]	[1.20]	[6.42]	[9.62]	[2.23]	[-2.74]	
HY/L	13.94	-0.98	0.05	-0.25	0.23***	0.06	0.22***	0.35***	-0.05	-0.03	0.55***	0.75
				[-0.98]	[5.07]	[0.94]	[3.11]	[4.41]	[-0.76]	[-0.26]	[4.85]	
HY/M	13.88	-0.38	-0.44	-0.17	0.17***	0.07	0.12**	0.46***	-0.05	0.01	-0.04	0.56
				[-0.65]	[3.12]	[1.06]	[2.02]	[5.86]	[-0.56]	[0.11]	[-0.41]	
HY/H	14.25	0.78	-0.59	0.96***	0.24***	0.05	0.20***	0.49***	0.11	-0.14	-1.22***	0.80
				[2.99]	[4.72]	[0.72]	[2.82]	[5.30]	[1.35]	[-1.27]	[-8.68]	

Panel C: Seven-Factor Model Triple-Sorted Portfolios on Rating, Basis, and Factor Loading

Rating/Basis/Loading	Rating	$Basis_{residual}$	Loading	Eret	Intercept	MKT	SMB	HML	DEF	TERM	LIQ	LMH	R^2
IG/L/L	7.61	-0.42	-0.44	0.52	1.47***	0.00	-0.03	0.05*	0.48***	0.44***	0.07	0.25***	0.77
					[5.22]	[0.07]	[-0.69]	[1.96]	[7.32]	[5.66]	[0.82]	[3.31]	
IG/L/M	7.77	-0.40	0.04	0.38	1.39***	0.04	-0.01	0.02	0.37***	0.37***	0.00	0.09	0.71
					[8.62]	[1.42]	[-0.55]	[0.63]	[7.38]	[7.97]	[0.09]	[1.44]	
IG/L/H	8.00	-0.43	0.54	0.26	1.42***	0.02	-0.07	0.01	0.44***	0.42***	-0.07	0.07	0.73
					[6.61]	[0.71]	[-1.47]	[0.22]	[8.06]	[7.35]	[-1.07]	[0.81]	
IG/M/L	7.42	0.02	-0.34	-0.22	0.94***	0.02	-0.05	0.02	0.43***	0.40***	0.08	0.00	0.66
					[5.73]	[0.61]	[-1.11]	[0.63]	[7.24]	[9.88]	[1.05]	[0.08]	
IG/M/M	7.49	0.03	0.00	-0.19	0.87***	0.03	-0.01	0.02	0.31***	0.33***	0.08	-0.04	0.61
					[8.48]	[1.62]	[-0.37]	[0.63]	[7.47]	[12.8]	[1.47]	[-0.94]	
IG/M/H	7.43	0.38	0.37	-0.33	0.82***	0.04*	-0.01	0.02	0.32***	0.37***	0.11**	-0.02	0.70
					[5.22]	[1.91]	[-0.50]	[1.04]	[8.64]	[9.47]	[2.3]	[-0.29]	
IG/H/L	7.08	0.38	-0.31	-0.77	0.20	0.01	-0.04	0.03	0.28***	0.27***	0.14*	-0.12**	0.53
					[1.45]	[0.59]	[-0.95]	[0.93]	[6.03]	[7.27]	[1.93]	[-2.13]	
IG/H/M	6.63	0.39	0.00	-0.55	0.31***	0.02	0.00	0.01	0.22***	0.26***	0.12**	-0.08**	0.51
					[2.8]	[1.11]	[0.10]	[0.61]	[5.73]	[8.64]	[2.33]	[-2.10]	
IG/H/H	7.12	0.34	0.30	-0.82	0.08	0.02	0.02	0.10***	0.24***	0.26***	0.16*	-0.11**	0.61
					[0.61]	[1.12]	[0.72]	[3.48]	[3.98]	[7.30]	[1.96]	[-2.00]	
HY/L/L	14.21	-0.74	-0.63	-0.42	-0.15	0.23***	0.07	0.13*	0.31***	-0.13	0.17	0.40***	0.70
					[-0.33]	[5.05]	[0.98]	[1.80]	[2.60]	[-0.98]	[0.86]	[3.89]	
HY/L/M	13.65	-0.83	0.07	-0.48	-0.20	0.16***	0.05	0.20***	0.45***	0.04	-0.17	0.71***	0.68
					[-0.70]	[4.15]	[0.86]	[3.03]	[5.7]	[0.55]	[-1.05]	[5.56]	
HY/L/H	14.11	-0.84	0.64	-0.77	-0.27	0.26***	-0.10	0.29***	0.40***	-0.01	-0.14	0.48*	0.71
					[-0.93]	[3.78]	[-0.86]	[3.64]	[3.22]	[-0.13]	[-1.40]	[1.94]	
HY/M/L	13.93	0.02	-0.98	-0.91	-0.04	0.16*	-0.02	0.17	0.52***	-0.12	-0.02	-0.31	0.62
					[-0.06]	[1.93]	[-0.22]	[1.61]	[4.31]	[-0.74]	[-0.13]	[-1.16]	
HY/M/M	13.77	0.01	-0.15	-0.64	-0.24	0.10*	0.10	0.19***	0.50***	0.02	0.02	0.24**	0.58
					[-1.15]	[1.84]	[1.49]	[3.81]	[5.86]	[0.25]	[0.12]	[2.39]	
HY/M/H	14.18	0.01	0.53	-1.34	-0.67**	0.16**	-0.04	0.25***	0.59***	-0.16*	-0.11	0.04	0.58
					[-2.43]	[2.27]	[-0.41]	[2.92]	[3.63]	[-1.82]	[-0.78]	[0.23]	
HY/H/L	14.28	0.92	-1.55	-1.09	1.50**	0.22***	-0.12	0.27***	0.64***	0.10	-0.07	-1.81***	0.77
					[2.40]	[3.14]	[-1.03]	[2.64]	[4.90]	[0.67]	[-0.42]	[-6.16]	
HY/H/M	14.01	0.77	-0.39	-1.02	0.84**	0.18***	0.05	0.27***	0.53***	0.12	-0.27**	-1.12***	0.77
					[2.15]	[3.46]	[0.59]	[3.98]	[5.20]	[1.34]	[-2.40]	[-5.68]	
HY/H/H	14.63	0.69	0.48	-1.62	0.26	0.24***	-0.05	0.14	0.46***	0.07*	-0.11	-0.57***	0.79
					[1.22]	[4.51]	[-0.82]	[1.52]	[5.78]	[1.69]	[-1.15]	[-4.14]	

Table 8. Risk or Mispricing? Explanatory Power of Residual Basis and Basis Factor LMH

This table presents the estimated coefficients of Fama-MacBeth (1973) regressions of bond returns on bond characteristics and risk factor loading. In Panel A, returns of 18 triple-sorted portfolios (2×3×3) based on two rating categories (IG, HY), three residual basis groups (L, M, H), and three preformation LMH loading groups (L, M, H) are regressed on each portfolio's basis ($Basis_{predicted}$ and $Basis_{residual}$), other bond characteristics (Rating, Coupon, Size, Age, Indliq), and risk factor loading (betas of *MKT, SMB, HML, DEF, TERM, LIQ, FLIQ*, and *LMH* factors). *Basis* is defined as (CDS spread – Z-spread) for the individual bond. $Basis_{predicted}$ is the predicted component of *Basis* by the model in Bai and Collin-Dufresne (2014) and $Basis_{residual}$ is defined as ($Basis - Basis_{predicted}$). *Rating* is a categorical variable ranging from 1 to 20 for all bonds (S&P rating AAA to CC). We use the S&P ratings whenever available, followed by Moody's and Fitch's ratings. *Coupon* is in percentage terms. *Issue size* is the natural logarithm of the issuance amount in billions. *Age* is in years. *Indliq* is the 20-day cumulative turnover measured as the total trading volume divided by the total number outstanding. β_{MKT}, β_{SMB}, β_{HML}, β_{DEF}, β_{TERM}, β_{LIQ}, β_{FLIQ} and β_{LMH} is betas of *MKT, SMB, HML, DEF, TERM, LIQ, FLIQ,* and *LMH* respectively. *MKT*, *SMB*, and *HML* are Fama-French (1993) three factors. *DEF* is the difference between the daily return of the Lehman investment-grade bond index return from Datastream and the daily 10-year-to-maturity government bond return from CRSP. *TERM* is the difference between the daily return of the 10-year-to-maturity government bond index and the daily T-bill return. *LIQ* is the market liquidity risk factor in Amihud (2002). *FLIQ* is the funding liquidity risk factor proxied by TED, the average of the 3-month uncollateralized LIBOR rate minus the 3-month T-bill rate. The basis factor, *LMH* (Low minus High), is defined as the return differential between the low residual basis portfolio and the high residual basis portfolio, i.e., (IG/L+HY/L)/2 – (IG/H+HY/H)/2. The results for individual bond returns are reported in Panel B. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Portfolio-level Regression

	Dependent Variable: Bond Return													
	$Basis_{residual}$	Rating	Coupon	Size	Age	Indliq	β_{MKT}	β_{SMB}	β_{HML}	β_{DEF}	β_{TERM}	β_{LIQ}	β_{FLIQ}	β_{LMH}
Model1														0.26*
														[1.66]
Model2	-0.54***													
	[-4.46]													
Model3	-0.90***													-0.43*
	[-5.25]													[-1.83]
Model4	-0.80***						-0.43	1.04**	-0.83	-0.37	0.77	0.14	0.17	-0.14
	[-6.15]						[-0.42]	[2.28]	[-1.04]	[-0.86]	[1.37]	[0.46]	[1.28]	[-0.85]
Model5	-0.79***	-0.04	-0.03	0.03	0.05	0.59	1.18	0.94*	-0.20	0.45	0.85	0.08	0.09	-0.04
	[-5.51]	[-0.97]	[-0.33]	[0.22]	[0.71]	[0.26]	[0.68]	[1.79]	[-0.34]	[0.63]	[1.20]	[0.20]	[0.58]	[-0.22]

Panel B: Bond-level Regression

	Dependent Variable: Bond Return													
	$Basis_{residual}$	Rating	Coupon	Size	Age	Indliq	β_{MKT}	β_{SMB}	β_{HML}	β_{DEF}	β_{TERM}	β_{LIQ}	β_{FLIQ}	β_{LMH}
Model1														-0.16
														[-1.08]
Model2	-0.78***													
	[-7.18]													
Model3	-0.87***													-0.27*
	[-11.06]													[-1.87]
Model4	-0.75***						-1.30	-0.16	-0.29	-0.76*	-0.38***	-0.29	0.15*	-0.31**
	[-11.77]						[-1.49]	[-0.50]	[-0.75]	[-1.81]	[-8.45]	[-1.07]	[1.83]	[-2.42]
Model5	-0.79***	-0.03	-0.01	0.04	-0.03	0.93	-0.79	-0.21	-0.14	-0.50	-0.34***	-0.22	0.15*	-0.28**
	[-11.65]	[-1.39]	[-0.51]	[0.91]	[-1.27]	[1.42]	[-1.03]	[-0.67]	[-0.42]	[-1.32]	[-7.79]	[-0.83]	[1.86]	[-2.18]

Table 9. Robustness Test for Market Microstructure

This table reports the predictive power of residual and predicted basis for future bond returns and CDS from 2003 through 2008 *after taking into account the market microstructure*. Average daily coefficients and *t*-statistics are reported for Fama-Macbeth (1973) regressions for individual bond's excess returns for *k* days (*k*=20, 40, and 60). The dependent variable in Panel A is the individual bond's *k*-day excess return from day *t+1* to day *t+1+k*. *Basis* is defined as (CDS spread – Z-spread) on day *t* for the individual bond. $Basis_{predicted}$ is the predicted component of *Basis* by the model in Bai and Collin-Dufresne (2014) and $Basis_{residual}$ is defined as ($Basis - Basis_{predicted}$). *Bond Return* is the individual bond's lagged *k*-day excess return from day *t–k* to day *t*. *CDS Spread* is the CDS spread on day *t* and *Δ(CDS Spread)* is the rate of CDS spread changes from day *t–k* to day *t*. *Rating* is a categorical variable ranging from 1 to 20 for all bonds (S&P rating AAA to CC). We use the S&P ratings whenever available, followed by Moody's and Fitch's ratings. *Coupon* is in percentage terms. *Issue size* is the natural logarithm of the issuance amount in billions. *Maturity* and *age* are in years. *Indliq* is the *k*-day cumulative turnover measured as the total trading volume divided by the total number outstanding. The dependent variable in Panel B is the rate of CDS spread changes from day *t+1* to day *t+k+1*. *Δ(CDSliq)* is the *k*-day change in the number of CDS dealers' quotes. *Stock return* is the rate of changes in stock prices within the past one month. *Δ(Volatility)* is the rate of change in stock volatility within the past one month, where stock volatility is defined as the standard deviation of daily stock returns measured in a 60-day window. *Δ(Leverage)* is the rate of change in market leverage within the past three months, where market leverage is measured by the book value of total debt divided by the market value of total assets. *Δ(Size)* is the rate of change in the logarithm of the market value of total assets within the past three months. *Δ(Profitability)* is the rate of change in net income divided by the market value of total assets within the past three months. *Δ(Cash)* is defined as the rate of change in cash ratio in the past three months. The cash ratio is defined as the ratio of cash and cash equivalent divided by the market value of total assets. The Newey-West t-statistics are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Predictability of Future Bond Returns

	Dependent Variabe: Future Bond Return								
	k=20			k=40			k=60		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
$Basis_{residual}$	-0.21***	-0.20***	-0.23***	-0.35***	-0.34***	-0.35***	-0.47***	-0.47***	-0.50***
	[-5.18]	[-5.14]	[-5.68]	[-4.83]	[-4.75]	[-4.27]	[-4.13]	[-4.08]	[-4.06]
$Basis_{predicted}$	-0.13	-0.12	-0.16*	-0.24	-0.24	-0.27	-0.20	-0.23	-0.29
	[-1.37]	[-1.32]	[-1.87]	[-1.18]	[-1.18]	[-1.44]	[-0.66]	[-0.73]	[-1.02]
CDS Spread	0.11	0.11	0.11	0.18	0.20	0.18	0.21	0.22	0.24
	[1.52]	[1.60]	[1.61]	[1.24]	[1.38]	[1.30]	[0.92]	[1.01]	[1.11]
Δ(CDS Spread)		-0.00***			-0.00**			-0.00**	
		[-4.01]			[-2.26]			[-2.22]	
Bond Return			0.01			0.00			0.03
			[1.32]			[0.19]			[1.01]
Rating	-0.05**	-0.05**	-0.05**	-0.10**	-0.11**	-0.09**	-0.11*	-0.12*	-0.11*
	[-2.49]	[-2.52]	[-2.49]	[-1.96]	[-2.12]	[-1.98]	[-1.71]	[-1.90]	[-1.74]
Maturity	-0.01	-0.01	-0.01	-0.02	-0.02	-0.03	-0.04	-0.04	-0.04
	[-0.78]	[-0.79]	[-0.84]	[-1.11]	[-1.05]	[-1.22]	[-1.37]	[-1.31]	[-1.44]
Age	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.02	-0.02	-0.02
	[-1.03]	[-0.98]	[-0.92]	[-0.79]	[-0.90]	[-0.64]	[-0.93]	[-0.97]	[-0.75]
Coupon	0.01	0.01	0.00	0.02	0.02	0.02	0.03	0.04	0.02
	[0.26]	[0.32]	[-0.00]	[0.60]	[0.69]	[0.54]	[0.66]	[0.89]	[0.34]
Issue Size	0.02	0.02	0.02	0.07	0.08	0.07	0.04	0.03	0.06
	[0.34]	[0.50]	[0.47]	[0.70]	[0.78]	[0.75]	[0.35]	[0.26]	[0.52]
Indliq	-0.58	-0.60	-0.59	-0.45	-0.41	-0.43	-0.53	-0.49	-0.58
	[-1.41]	[-1.51]	[-1.43]	[-0.88]	[-0.81]	[-0.81]	[-0.93]	[-0.85]	[-1.01]
N	169,213	169,213	169,213	127,196	127,196	127,196	121,261	121,261	121,261
R^2	0.21	0.21	0.22	0.34	0.34	0.35	0.41	0.41	0.42

Panel B: Predictability of Future Change in CDS

	Dependent Variabe: Future ΔCDS								
	k=20			k=40			k=60		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
$Basis_{residual}$	-1.91***	-1.84***	-2.17***	-3.20***	-3.13***	-3.54***	-4.33***	-4.06***	-4.32***
	[-5.31]	[-4.98]	[-5.77]	[-4.36]	[-3.93]	[-4.97]	[-3.36]	[-2.81]	[-3.58]
$Basis_{predicted}$	0.02	0.30	-0.16	2.45	2.60	2.02	2.91	2.20	2.32
	[0.02]	[0.31]	[-0.16]	[1.09]	[1.17]	[0.94]	[0.77]	[0.61]	[0.63]
CDS Spread	-1.90**	-1.70**	-2.02**	-3.73**	-3.44**	-4.23***	-4.77**	-4.58**	-5.58***
	[-2.50]	[-2.20]	[-2.55]	[-2.53]	[-2.28]	[-2.69]	[-2.43]	[-2.14]	[-2.60]
Δ(CDS Spread)		-0.06***			-0.08***			-0.12***	
		[-2.79]			[-3.50]			[-3.39]	
Bond Return			0.26***			0.53***			0.67**
			[4.25]			[4.12]			[2.45]
Δ(CDSliq)	1.04	0.93	0.96	-1.68	-1.31	-1.63	-3.63**	-2.70*	-3.49**
	[1.48]	[1.41]	[1.37]	[-1.63]	[-1.38]	[-1.56]	[-2.30]	[-1.78]	[-2.28]
Stock Return	-0.21***	-0.22***	-0.22***	-0.23***	-0.27***	-0.24***	-0.23**	-0.30***	-0.25***
	[-5.17]	[-5.38]	[-5.54]	[-2.99]	[-3.67]	[-3.32]	[-2.42]	[-3.13]	[-2.68]
Δ(Volatility)	0.98	0.84	1.00*	1.71*	2.31**	1.81*	0.95	1.44	0.95
	[1.60]	[1.47]	[1.66]	[1.79]	[2.31]	[1.87]	[0.68]	[1.03]	[0.67]
Δ(Leverage)	2.30	2.23	2.30	2.00	2.65	2.39	2.16	2.07	2.63
	[0.91]	[0.89]	[0.91]	[0.47]	[0.63]	[0.57]	[0.35]	[0.33]	[0.44]
Δ(Size)	-0.92***	-0.88***	-0.97***	-2.27***	-2.31***	-2.29***	-2.92***	-3.20***	-2.97***
	[-2.76]	[-2.64]	[-3.02]	[-3.55]	[-3.70]	[-3.56]	[-3.08]	[-3.35]	[-3.18]
Δ(Profitability)	0.14	0.22	0.24	-0.06	0.12	-0.02	-0.15	0.14	-0.13
	[0.40]	[0.63]	[0.70]	[-0.08]	[0.17]	[-0.03]	[-0.20]	[0.18]	[-0.16]
Δ(Cash)	0.07	-0.03	0.02	-0.96	-1.11	-1.01	-2.04	-1.95	-2.00
	[0.15]	[-0.06]	[0.05]	[-1.00]	[-1.12]	[-1.06]	[-1.62]	[-1.41]	[-1.53]
N	113,297	113,297	113,297	107,331	107,331	107,331	101,354	101,354	101,354
R^2	0.17	0.20	0.17	0.18	0.22	0.19	0.20	0.23	0.21

Table 10. Predictive Power of Basis for Price Convergence: IG and HY

This table reports robustness tests for the predictive power of residual and predicted basis for future bond returns and CDS spreads from 2003 through 2008 for two subsamples based on credit ratings such as investment grade (IG) and speculative grade (HY). The dependent variable in Panel A is the future bond return from day *t* to day *t+k* (*k*=20, 40, and 60). *Basis* is defined as (CDS spread – Z-spread) on day *t* for the individual bond. $Basis_{predicted}$ is the predicted component of *Basis* by the model in Bai and Collin-Dufresne (2014), and $Basis_{residual}$ is computed as ($Basis$ – $Basis_{predicted}$). *Bond Return* is the individual bond's lagged *k*-day excess return from day *t–k* to day *t*. *CDS Spread* is the CDS spread on day *t,* and *Δ(CDS Spread)* is the rate of CDS spread changes from day *t-k* to day *t*. *Rating* is a categorical variable ranging from 1 to 20 for all bonds (S&P rating AAA to CC). We use the S&P ratings whenever available, followed by Moody's and Fitch's ratings. *Coupon* is in percentage terms. *Issue size* is the natural logarithm of the issuance amount in billions. *Maturity* and *age* are in years. *Indliq* is the *k*-day cumulative turnover measured as the total trading volume divided by the total number outstanding. The dependent variable in Panel B is the change in CDS spread from day *t* to day *t+k*. *Δ(CDSliq)* is the *k*-day change in the number of CDS dealers' quotes. *Stock return* is the rate of changes in stock prices within the past one month. *Δ(Volatility)* is the rate of change in stock volatility within the past one month, where stock volatility is defined as the standard deviation of daily stock returns measured in a 60-day window. *Δ(Leverage)* is the rate of change in market leverage within the past three months, where market leverage is measured by the book value of total debt divided by the market value of total assets. *Δ(Size)* is the rate of change in the logarithm of the market value of total assets within the past three months. *Δ(Profitability)* is the rate of change in net income divided by the market value of total assets within the past three months. *Δ(Cash)* is defined as the rate of change in cash ratio in the past three months. The cash ratio is defined as the ratio of cash and cash equivalent divided by the market value of total assets. "Investment Grade ΔCDS" and "Speculative Grade ΔCDS" subsamples refer to the future change of CDS with different credit ratings. The Newey-West t-statistics are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Residual Basis with Future Bond Returns

	Investment Grade Bonds									Speculative Grade Bonds								
	k=20			k=40			k=60			k=20			k=40			k=60		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14	Model 15	Model 16	Model 17	Model 18
$Basis_{residual}$	-2.33***	-2.33***	-1.68***	-2.47***	-2.48***	-1.82***	-2.66***	-2.67***	-2.10***	-1.14***	-1.19***	-0.87***	-1.46***	-1.49***	-1.23***	-1.65***	-1.65***	-1.50***
	[-40.46]	[-39.94]	[-31.99]	[-24.46]	[-24.08]	[-15.95]	[-17.27]	[-16.98]	[-12.10]	[-15.10]	[-15.36]	[-12.36]	[-12.93]	[-12.96]	[-9.75]	[-9.44]	[-9.64]	[-8.25]
$Basis_{predicted}$	-1.94***	-1.96***	-1.43***	-2.01***	-2.04***	-1.47***	-1.98***	-2.00***	-1.54***	-1.05***	-1.10***	-0.77***	-1.32***	-1.32***	-1.09***	-1.39***	-1.41***	-1.24***
	[-23.78]	[-23.67]	[-18.00]	[-14.84]	[-15.50]	[-9.52]	[-7.68]	[-7.73]	[-5.77]	[-9.71]	[-10.60]	[-6.76]	[-7.99]	[-7.76]	[-6.53]	[-6.19]	[-6.10]	[-5.28]
CDS Spread	0.28***	0.27***	0.13	0.11	0.09	-0.07	0.03	0.00	-0.13	0.48***	0.50***	0.34***	0.58***	0.58***	0.44***	0.57***	0.61***	0.48**
	[3.50]	[3.42]	[1.54]	[0.62]	[0.49]	[-0.34]	[0.11]	[0.01]	[-0.41]	[7.77]	[7.96]	[4.96]	[4.93]	[4.67]	[3.25]	[3.03]	[3.35]	[2.33]
Δ(CDS Spread)		0.00			0.00			0.00			0.00			0.00			-0.01*	
		[0.24]			[1.12]			[0.88]			[-1.07]			[0.82]			[-1.76]	
Bond Return			-0.29***			-0.27***			-0.23***			-0.22***			-0.18***			-0.10***
			[-39.68]			[-20.22]			[-13.35]			[-10.83]			[-6.29]			[-3.54]
Rating	-0.14***	-0.14***	-0.10***	-0.14***	-0.14***	-0.09***	-0.13***	-0.13***	-0.09***	0.05	0.06	0.08**	0.04	0.05	0.08	0.06	0.01	0.07
	[-7.31]	[-7.35]	[-5.84]	[-4.47]	[-4.54]	[-3.67]	[-4.10]	[-3.95]	[-2.99]	[1.09]	[1.37]	[1.97]	[0.39]	[0.46]	[0.87]	[0.36]	[0.09]	[0.42]
Maturity	-0.04***	-0.04***	-0.03***	-0.05***	-0.05***	-0.04**	-0.06**	-0.06**	-0.05**	-0.03**	-0.03**	-0.02**	-0.05**	-0.05*	-0.05*	-0.07**	-0.07**	-0.07**
	[-4.64]	[-4.71]	[-2.96]	[-2.91]	[-2.88]	[-2.01]	[-2.57]	[-2.57]	[-2.14]	[-2.37]	[-2.40]	[-2.09]	[-2.01]	[-1.89]	[-1.93]	[-2.07]	[-2.12]	[-2.03]
Age	-0.02***	-0.02***	-0.01**	-0.01*	-0.01*	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.03	-0.04	-0.03	-0.07	-0.07	-0.06
	[-3.73]	[-3.70]	[-2.58]	[-1.71]	[-1.87]	[-0.73]	[-1.20]	[-1.43]	[-0.68]	[-0.82]	[-0.90]	[-0.68]	[-0.95]	[-1.19]	[-0.90]	[-1.29]	[-1.34]	[-1.13]
Coupon	-0.10***	-0.10***	-0.07***	-0.09***	-0.09***	-0.07***	-0.11***	-0.10***	-0.08***	-0.09**	-0.10**	-0.04	-0.06	-0.06	-0.02	0.00	0.00	0.03
	[-7.80]	[-8.16]	[-5.64]	[-4.72]	[-5.37]	[-3.93]	[-6.13]	[-6.74]	[-5.27]	[-2.09]	[-2.29]	[-1.02]	[-1.02]	[-1.04]	[-0.26]	[-0.02]	[0.02]	[0.33]
Issue Size	0.15***	0.15***	0.09***	0.16***	0.16***	0.11***	0.16***	0.16***	0.11**	-0.11*	-0.08	-0.09	-0.11	-0.08	-0.09	-0.14	-0.14	-0.11
	[6.35]	[6.31]	[4.24]	[3.75]	[3.60]	[2.70]	[3.37]	[3.41]	[2.41]	[-1.76]	[-1.36]	[-1.48]	[-1.07]	[-0.77]	[-0.81]	[-0.92]	[-0.90]	[-0.73]
Indliq	0.82**	0.83**	0.77**	0.37	0.38	0.31	0.43*	0.44*	0.36	-2.38**	-2.59**	-1.62	-2.09	-1.92	-1.57	-1.12	-1.28	-0.99
	[2.44]	[2.50]	[2.24]	[1.50]	[1.59]	[1.13]	[1.68]	[1.75]	[1.32]	[-2.04]	[-2.08]	[-1.37]	[-1.60]	[-1.61]	[-1.20]	[-0.74]	[-0.81]	[-0.70]
N	141,485	141,485	141,485	134,304	134,304	134,304	127,247	127,247	127,247	39,543	39,543	39,543	38,016	38,016	38,016	36,082	36,082	36,082
R^2	0.30	0.30	0.36	0.38	0.38	0.43	0.42	0.43	0.46	0.31	0.33	0.37	0.42	0.43	0.46	0.46	0.47	0.48

Panel B: Residual Basis with Future CDS Spread Changes

	Investment Grade ΔCDS									Speculative Grade ΔCDS								
	k=20			k=40			k=60			k=20			k=40			k=60		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14	Model 15	Model 16	Model 17	Model 18
$Basis_{residual}$	-2.51***	-2.34***	-2.92***	-4.02***	-3.50***	-4.35***	-5.33***	-4.50***	-5.19***	-1.46***	-1.44***	-1.38***	-1.57***	-1.28***	-1.75***	-1.26	-1.07	-1.46
	[-7.17]	[-6.40]	[-7.11]	[-5.31]	[-4.34]	[-5.22]	[-4.46]	[-3.71]	[-3.68]	[-6.04]	[-6.38]	[-5.27]	[-2.98]	[-2.70]	[-2.88]	[-1.42]	[-1.27]	[-1.52]
$Basis_{predicted}$	-0.22	0.57	-0.46	0.08	1.09	-0.22	1.51	3.49	1.19	-0.26	-0.47	-0.22	0.72	0.99	0.67	3.47	3.44	3.23
	[-0.14]	[0.37]	[-0.29]	[0.02]	[0.31]	[-0.06]	[0.26]	[0.57]	[0.20]	[-0.42]	[-0.77]	[-0.38]	[0.41]	[0.52]	[0.40]	[1.17]	[1.17]	[1.12]
CDS Spread	-3.00***	-2.14**	-3.12***	-4.93**	-3.62*	-5.61***	-6.81**	-4.57	-8.09**	0.12	0.20	0.10	-0.39	-0.35	-0.41	-1.54	-1.36	-1.39
	[-3.40]	[-2.32]	[-3.42]	[-2.53]	[-1.88]	[-2.81]	[-2.18]	[-1.33]	[-2.49]	[0.44]	[0.72]	[0.37]	[-0.59]	[-0.52]	[-0.66]	[-1.42]	[-1.29]	[-1.29]
Δ(CDS Spread)		-0.11***			-0.08***			-0.11***			-0.01			-0.18***			-0.14	
		[-6.65]			[-3.47]			[-3.62]			[-0.28]			[-3.09]			[-1.63]	
Bond Return			0.33***			0.45***			0.43*			0.03			0.13			0.29
			[4.91]			[3.58]			[1.84]			[0.46]			[1.31]			[1.51]
Δ(CDSliq)	0.78	1.02**	0.79	-0.27	0.18	-0.27	-1.13	0.04	-1.04	-0.57	-0.37	-0.68	-2.68***	-2.88**	-2.64**	-5.59**	-6.55**	-5.08**
	[1.50]	[1.98]	[1.51]	[-0.33]	[0.24]	[-0.34]	[-1.07]	[0.03]	[-1.00]	[-0.83]	[-0.57]	[-0.97]	[-2.62]	[-2.52]	[-2.56]	[-2.47]	[-2.35]	[-2.40]
Stock Return	-0.21***	-0.24***	-0.22***	-0.24***	-0.29***	-0.25***	-0.28***	-0.33***	-0.29***	-0.23***	-0.24***	-0.23***	-0.21***	-0.29***	-0.22***	-0.35***	-0.40***	-0.36***
	[-4.76]	[-5.56]	[-4.91]	[-3.39]	[-4.12]	[-3.51]	[-3.92]	[-4.79]	[-4.16]	[-5.02]	[-5.18]	[-4.94]	[-3.39]	[-3.81]	[-3.62]	[-3.47]	[-3.98]	[-3.40]
Δ(Volatility)	0.57	0.54	0.62	0.07	0.52	0.18	0.46	0.94	0.59	1.36	1.30	1.42	0.54	0.53	0.40	1.31	1.64	1.16
	[1.06]	[1.04]	[1.14]	[0.08]	[0.58]	[0.21]	[0.30]	[0.64]	[0.39]	[1.36]	[1.27]	[1.36]	[0.25]	[0.25]	[0.19]	[0.45]	[0.54]	[0.39]
Δ(Leverage)	3.10	3.18	3.17	3.04	3.14	3.18	0.64	1.12	0.95	-3.16	-2.15	-3.33	-11.65	-10.12	-10.98	-10.82	-10.65	-10.76
	[1.41]	[1.44]	[1.43]	[0.83]	[0.86]	[0.88]	[0.12]	[0.22]	[0.18]	[-0.85]	[-0.64]	[-0.90]	[-1.02]	[-0.85]	[-0.96]	[-0.58]	[-0.60]	[-0.59]
Δ(Size)	-0.65**	-0.61**	-0.69**	-1.87***	-1.81***	-1.91***	-2.85***	-3.05***	-2.88***	-0.95**	-0.93***	-0.96**	-2.68***	-2.81***	-2.66***	-2.12	-2.23	-2.17
	[-2.26]	[-2.06]	[-2.41]	[-3.17]	[-3.05]	[-3.22]	[-3.19]	[-3.34]	[-3.21]	[-2.57]	[-2.73]	[-2.58]	[-2.66]	[-2.62]	[-2.61]	[-1.26]	[-1.34]	[-1.30]
Δ(Profitability)	0.19	0.33	0.20	0.33	0.47	0.36	0.74	0.77	0.81	-0.28	-0.33	-0.25	-0.52	-0.14	-0.30	-0.24	0.84	-0.22
	[0.61]	[1.02]	[0.62]	[0.62]	[0.89]	[0.70]	[1.10]	[1.13]	[1.20]	[-1.20]	[-1.25]	[-1.09]	[-0.79]	[-0.14]	[-0.46]	[-0.24]	[0.55]	[-0.21]
Δ(Cash)	-0.39	-0.44	-0.42	-1.14	-1.17*	-1.20*	-1.60	-1.48	-1.57	0.49	0.24	0.43	1.45	1.30	1.65	1.34	1.70	1.24
	[-1.11]	[-1.19]	[-1.18]	[-1.63]	[-1.72]	[-1.73]	[-1.48]	[-1.30]	[-1.46]	[0.80]	[0.43]	[0.72]	[1.26]	[1.00]	[1.46]	[0.63]	[0.84]	[0.58]
N	139,672	139,672	139,672	130,582	130,582	130,582	123,797	123,797	123,797	39,085	39,085	39,085	37,551	37,551	37,551	35,648	35,648	35,648
R^2	0.16	0.20	0.16	0.18	0.22	0.19	0.19	0.23	0.20	0.35	0.40	0.36	0.37	0.42	0.37	0.38	0.43	0.38

Table 11. Predictive Power of Basis for Price Convergence: Pre-Crisis and Crisis Periods

This table reports robustness tests for the predictive power of residual and predicted basis for future bond returns and CDS spreads from 2003 through 2008 for two subsamples such as pre-crisis and crisis period. Pre-crisis period spans from March 2003 through June 2007. Crisis period spans from July 2007 through December 2008. The dependent variable in Panel A is the future bond return from day *t* to day *t+k* (*k*=20, 40, and 60). *Basis* is defined as (CDS spread – Z-spread) on day *t* for the individual bond. $Basis_{predicted}$ is the predicted component of *Basis* by the model in Bai and Collin-Dufresne (2014), and $Basis_{residual}$ is computed as ($Basis - Basis_{predicted}$). *Bond Return* is the individual bond's lagged *k*-day excess return from day *t-k* to day *t*. *CDS Spread* is the CDS spread on day *t,* and *Δ(CDS Spread)* is the rate of CDS spread changes from day *t*–20 to day *t*. *Rating* is a categorical variable ranging from 1 to 20 for all bonds (S&P rating AAA to CC). We use the S&P ratings whenever available, followed by Moody's and Fitch's ratings. *Coupon* is in percentage terms. *Issue size* is the natural logarithm of the issuance amount in billions. *Maturity* and *age* are in years. *Indliq* is the k-day cumulative turnover measured as the total trading volume divided by the total number outstanding. The dependent variable in Panel B is the change in CDS spread from day *t* to day *t+k*. *Δ(CDSliq)* is the *k*-day change in the number of CDS dealers' quotes. *Stock return* is the rate of changes in stock prices within the past one month. *Δ(Volatility)* is the rate of change in stock volatility within the past one month, where stock volatility is defined as the standard deviation of daily stock returns measured in a 60-day window. *Δ(Leverage)* is the rate of change in market leverage within the past three months, where market leverage is measured by the book value of total debt divided by the market value of total assets. *Δ(Size)* is the rate of change in the logarithm of the market value of total assets within the past three months. *Δ(Profitability)* is the rate of change in net income divided by the market value of total assets within the past three months. *Δ(Cash)* is defined as the rate of change in the cash ratio in the past three months. The cash ratio is defined as the ratio of cash and cash equivalent divided by the market value of total assets. The Newey-West t-statistics are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Residual Basis with Future Bond Returns

	Pre-crisis Period									Crisis Period								
	k=20			k=40			k=60			k=20			k=40			k=60		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14	Model 15	Model 16	Model 17	Model 18
$Basis_{residual}$	-1.74***	-1.75***	-1.30***	-1.98***	-1.98***	-1.60***	-2.19***	-2.20***	-1.88***	-1.45***	-1.44***	-1.01***	-1.53***	-1.54***	-0.98***	-1.43***	-1.43***	-1.04***
	[-23.53]	[-23.97]	[-22.35]	[-19.28]	[-19.64]	[-17.51]	[-16.40]	[-16.69]	[-15.35]	[-14.25]	[-13.92]	[-10.57]	[-8.15]	[-7.95]	[-5.16]	[-4.23]	[-4.04]	[-3.06]
$Basis_{predicted}$	-1.48***	-1.49***	-1.08***	-1.61***	-1.61***	-1.31***	-1.63***	-1.64***	-1.41***	-1.05***	-1.06***	-0.65***	-1.15***	-1.18***	-0.66	-1.08	-1.09	-0.70
	[-11.93]	[-12.21]	[-9.68]	[-7.62]	[-7.73]	[-6.89]	[-5.52]	[-5.70]	[-5.43]	[-5.42]	[-5.43]	[-3.31]	[-2.82]	[-2.89]	[-1.56]	[-1.48]	[-1.52]	[-0.94]
CDS Spread	0.44***	0.45***	0.39***	0.57***	0.58***	0.56***	0.72***	0.72***	0.74***	0.33***	0.33***	0.13	0.17	0.17	-0.13	-0.12	-0.08	-0.40
	[5.55]	[5.64]	[5.22]	[3.96]	[4.04]	[4.04]	[3.71]	[3.82]	[3.98]	[3.26]	[3.22]	[1.14]	[0.77]	[0.81]	[-0.57]	[-0.38]	[-0.27]	[-1.21]
Δ(CDS Spread)		-0.00**			-0.00**			-0.00*			-0.00**			0.00			0.00	
		[-2.29]			[-1.97]			[-1.84]			[-2.14]			[-0.57]			[-0.77]	
Bond Return			-0.26***			-0.20***			-0.16***			-0.26***			-0.27***			-0.17***
			[-19.99]			[-8.55]			[-4.50]			[-12.93]			[-10.41]			[-4.47]
Rating	-0.07***	-0.07***	-0.04***	-0.07***	-0.07***	-0.05***	-0.06***	-0.07***	-0.03	-0.29***	-0.30***	-0.25***	-0.43***	-0.43***	-0.37***	-0.49***	-0.51***	-0.46***
	[-7.69]	[-7.83]	[-4.68]	[-4.63]	[-4.93]	[-2.90]	[-2.72]	[-3.13]	[-1.54]	[-4.81]	[-4.91]	[-3.89]	[-3.20]	[-3.27]	[-2.76]	[-3.21]	[-3.41]	[-2.84]
Maturity	-0.03***	-0.03***	-0.02**	-0.03**	-0.03*	-0.02	-0.04*	-0.04	-0.03	-0.04*	-0.04*	-0.04*	-0.11***	-0.10***	-0.11***	-0.17***	-0.16***	-0.17***
	[-3.39]	[-3.43]	[-2.02]	[-2.00]	[-1.93]	[-1.26]	[-1.73]	[-1.63]	[-1.40]	[-1.92]	[-1.96]	[-1.95]	[-2.69]	[-2.70]	[-2.65]	[-3.11]	[-3.20]	[-3.10]
Age	0.00	0.00	0.00	-0.01	-0.01	0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.02	-0.02	-0.02	-0.05	-0.06	-0.05
	[-0.24]	[-0.19]	[0.22]	[-0.55]	[-0.55]	[-0.12]	[-0.64]	[-0.70]	[-0.33]	[-0.59]	[-0.45]	[-0.62]	[-0.39]	[-0.44]	[-0.36]	[-0.63]	[-0.70]	[-0.66]
Coupon	-0.13***	-0.13***	-0.09***	-0.12***	-0.12***	-0.10***	-0.13***	-0.13***	-0.11***	-0.08	-0.09	-0.04	-0.06	-0.06	-0.01	0.00	0.03	0.05
	[-11.05]	[-11.16]	[-8.56]	[-6.14]	[-5.99]	[-4.98]	[-5.81]	[-5.52]	[-5.00]	[-1.39]	[-1.45]	[-0.65]	[-0.62]	[-0.60]	[-0.12]	[0.02]	[0.19]	[0.32]
Issue Size	0.04*	0.04**	0.02	0.04	0.05	0.02	0.02	0.02	0.01	0.19**	0.20**	0.14	0.30*	0.3	0.23	0.36	0.34	0.29
	[1.87]	[2.21]	[0.72]	[1.16]	[1.35]	[0.55]	[0.53]	[0.52]	[0.21]	[2.22]	[2.40]	[1.46]	[1.70]	[1.60]	[1.29]	[1.49]	[1.41]	[1.28]
Indliq	-0.23	-0.20	-0.10	-0.17	-0.16	-0.04	-0.28	-0.27	-0.21	1.75	1.76	2.04	0.45	0.56	0.48	-0.43	-0.36	-0.4
	[-0.76]	[-0.67]	[-0.33]	[-0.46]	[-0.44]	[-0.10]	[-0.82]	[-0.80]	[-0.65]	[1.20]	[1.20]	[1.47]	[0.39]	[0.47]	[0.40]	[-0.34]	[-0.27]	[-0.31]
N	142,015	142,015	142,015	136,910	136,910	136,910	131,229	131,229	131,229	39,013	39,013	39,013	35,410	35,410	35,410	32,100	32,100	32,100
R^2	0.30	0.31	0.36	0.41	0.41	0.45	0.45	0.45	0.49	0.33	0.33	0.38	0.44	0.44	0.47	0.51	0.51	0.53

Panel B: Residual Basis with Future CDS Spread Change

	Pre-crisis Period									Crisis Period								
	k=20			k=40			k=60			k=20			k=40			k=60		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14	Model 15	Model 16	Model 17	Model 18
$Basis_{residual}$	-2.50***	-2.49***	-2.71***	-4.31***	-4.14***	-4.67***	-5.67***	-5.37***	-5.71***	-0.75**	-0.67*	-1.00**	-0.54	-0.13	-0.62	0.28	0.81	1.46
	[-7.52]	[-7.22]	[-7.53]	[-5.92]	[-5.23]	[-6.97]	[-4.85]	[-3.95]	[-6.29]	[-2.15]	[-1.90]	[-2.27]	[-0.60]	[-0.15]	[-0.54]	[0.21]	[0.86]	[0.62]
$Basis_{predicted}$	-0.94	-0.64	-1.11	-0.45	-0.11	-0.87	-0.49	-0.48	-0.97	1.69	1.66*	1.46	4.64*	4.71*	4.50	9.06**	8.68**	9.63*
	[-1.00]	[-0.70]	[-1.19]	[-0.20]	[-0.05]	[-0.41]	[-0.13]	[-0.13]	[-0.27]	[1.61]	[1.66]	[1.34]	[1.72]	[1.84]	[1.58]	[2.06]	[1.99]	[1.92]
CDS Spread	-2.10***	-1.77**	-2.25***	-3.61**	-3.28**	-4.13**	-4.71**	-4.46*	-5.62**	-0.89	-0.79	-0.86	-2.53	-2.32	-2.62	-4.51	-4.40	-4.70
	[-2.59]	[-2.17]	[-2.67]	[-2.35]	[-2.16]	[-2.51]	[-2.13]	[-1.88]	[-2.35]	[-1.62]	[-1.42]	[-1.50]	[-1.61]	[-1.47]	[-1.59]	[-1.44]	[-1.39]	[-1.45]
Δ(CDS Spread)		-0.10***			-0.08***			-0.12***			-0.07***			-0.11*			-0.08	
		[-5.23]			[-3.72]			[-3.90]			[-2.88]			[-1.79]			[-1.05]	
Bond Return			0.27***			0.59***			0.66***			0.13			0.05			-0.45
			[4.20]			[5.29]			[3.67]			[1.34]			[0.24]			[-0.81]
Δ(CDSliq)	0.38	0.46	0.35	-0.40	-0.06	-0.38	-1.33	-0.50	-1.24	1.04	1.12	1.06	-1.88***	-1.67**	-1.99**	-4.61**	-4.11	-4.58**
	[0.72]	[0.89]	[0.66]	[-0.49]	[-0.08]	[-0.47]	[-1.28]	[-0.48]	[-1.23]	[1.19]	[1.29]	[1.24]	[-2.60]	[-2.22]	[-2.50]	[-2.06]	[-1.64]	[-2.06]
Stock Return	-0.20***	-0.23***	-0.21***	-0.19***	-0.24***	-0.20***	-0.16***	-0.22***	-0.18***	-0.30***	-0.33***	-0.31***	-0.38***	-0.41***	-0.37***	-0.55***	-0.58***	-0.53***
	[-5.40]	[-6.23]	[-5.63]	[-3.63]	[-4.59]	[-4.03]	[-3.24]	[-4.19]	[-3.86]	[-6.61]	[-7.15]	[-6.65]	[-3.00]	[-3.57]	[-2.94]	[-3.44]	[-4.28]	[-3.33]
Δ(Volatility)	0.70	0.62	0.75	0.04	0.24	0.07	0.15	0.36	0.17	1.76*	2.00**	1.71*	2.90**	3.99**	2.89**	3.04	3.29	2.78
	[1.20]	[1.13]	[1.29]	[0.04]	[0.29]	[0.08]	[0.13]	[0.35]	[0.15]	[1.88]	[2.14]	[1.84]	[2.11]	[2.59]	[2.09]	[0.90]	[0.95]	[0.83]
Δ(Leverage)	2.74	2.72	2.79	-0.46	0.10	-0.22	-3.64	-2.55	-2.87	2.69	2.94	2.82	8.85*	9.87*	8.65*	12.91**	13.62**	12.42**
	[1.12]	[1.12]	[1.12]	[-0.13]	[0.03]	[-0.07]	[-0.76]	[-0.53]	[-0.60]	[1.18]	[1.18]	[1.23]	[1.77]	[1.84]	[1.70]	[2.08]	[2.36]	[2.00]
Δ(Size)	-0.79***	-0.78***	-0.81***	-2.01***	-2.02***	-2.02***	-3.05***	-3.34***	-3.04***	-0.18	-0.26	-0.23	-0.30	-0.47	-0.40	0.17	-0.02	0.08
	[-2.91]	[-2.78]	[-3.00]	[-3.80]	[-3.80]	[-3.73]	[-4.24]	[-4.38]	[-4.07]	[-0.35]	[-0.47]	[-0.44]	[-0.39]	[-0.59]	[-0.53]	[0.10]	[-0.01]	[0.05]
Δ(Profitability)	0.34	0.47*	0.37	0.48	0.67	0.55	0.43	0.52	0.56	-0.47**	-0.47**	-0.48**	-0.88**	-0.81*	-0.86**	-2.07**	-1.97*	-2.20*
	[1.25]	[1.77]	[1.34]	[0.95]	[1.34]	[1.11]	[0.90]	[1.03]	[1.21]	[-2.00]	[-2.07]	[-1.98]	[-2.17]	[-1.91]	[-2.02]	[-1.98]	[-1.83]	[-1.91]
Δ(Cash)	-0.11	-0.16	-0.12	-1.05***	-1.18***	-1.09***	-1.85**	-1.83**	-1.84**	0.13	0.20	0.10	0.60	0.87	0.55	0.78	0.91	0.78
	[-0.56]	[-0.80]	[-0.59]	[-2.85]	[-3.09]	[-2.92]	[-2.33]	[-2.27]	[-2.30]	[0.15]	[0.24]	[0.12]	[0.30]	[0.46]	[0.28]	[0.28]	[0.31]	[0.28]
N	137,734	137,734	137,734	132,836	132,836	132,836	127,425	127,425	127,425	38,846	38,846	38,846	35,297	35,297	35,297	32,020	32,020	32,020
R^2	0.13	0.17	0.14	0.15	0.19	0.16	0.17	0.20	0.18	0.16	0.19	0.17	0.16	0.19	0.17	0.17	0.19	0.18

Appendix

A.1. Construction of a Residual Basis

In this appendix, we present how we estimate the residual basis by replicating the empirical model in Bai and Collin-Dufresne (2014). They have proposed that the persistent excessive negative basis during the recent financial crisis can be a result of arbitrage risk (such as the counterparty risk of the CDS issuer) and various funding costs related to arbitrage. The latter can be accelerated by "limits to arbitrage," which represents the inability of arbitrageurs to raise capital quickly and/or their unwillingness to take large positions in these arbitrage trades because of mark-to-market risk. These explanations differ from the conventional explanations (such as the cheapest-to-deliver option and the difficulty in short-selling bonds) that usually point to a positive basis (e.g., Blanco, Brennan, Marsh, 2005; Nashikkar, Subrahmanyam, and Mahanti, 2011).

Specifically, Bai and Collin-Dufresne (2014) propose that a basis investor faces five types of risk-return tradeoff: (1) counterparty risk; (2) uncollateralized funding costs (Libor-OIS spread); (3) collateralized funding cost (repo rates); (4) haircuts; and (5) transaction costs. They use the following cross-sectional regression model to remove the risk-return tradeoff faced by the basis investor for each bond *i*,

$$\begin{aligned} Basis_t^i = {} & \alpha_t + \gamma_{t,cp}\beta_{cp}^i + \gamma_{t,libor}\beta_{libor}^i + \gamma_{t,frepo}\beta_{frepo}^i + \gamma_{t,coll}Collateral^i \\ & + \gamma_{t,Liq}Liq^i + \gamma_{t,Bliq}\beta_{Bliq}^i + \gamma_{t,BliqMkt}\beta_{BLiqMkt}^i + \gamma_{t,mkt}\beta_{mkt}^i + \varepsilon_t^i, \forall t \end{aligned} \tag{A.1}$$

where

$$\beta_{cp}^i = \frac{\text{cov}(R_i, (R_{index} - R_{mkt}))}{\text{var}(R_{index} - R_{mkt})}, \tag{A.2}$$

$$\beta^i_{libor} = \frac{\text{cov}[\Delta CDS^i, \Delta(libor - ois)]}{\text{var}[\Delta(libor - ois)]}, \quad \text{(A.3)}$$

$$\beta^i_{frepo} = \frac{\text{cov}(\Delta CDS^i, \Delta RepoSpread)}{\text{var}(\Delta RepoSpread)}. \quad \text{(A.4)}$$

where R_i is the stock return of the underlying firm that has bond i, R_{index} is the primary dealer's index stock return, $\Delta(CDS)^i$ is the change in the CDS spread of the underlying firm that has bond i, *RepoSpread* is calculated as the 3-month general collateral repo rate minus the 3-month Treasury bill. $Collateral^i$ is an index measuring the collateral quality of bond i issued by each reference entity, consisting of firm size, leverage, tangible ratio, rating, CDS level, and CDS volatility. Liq^i is the underlying bond i's turnover rate to proxy for liquidity of the bond. β^i_{BLiq} is the co-movement between bond i's illiquidity and the bond market liquidity as the regression coefficient of its bond turnover on the entire bond market turnover. $\beta^i_{BLiqMkt}$ is the co-movement between bond i's illiquidity and the entire stock market return, which is measured by the CRSP value-weighted stock market return. β^i_{mkt} is the beta coefficient of the underlying firm's stock return with respect to the entire stock market return, which is measured by CRSP value-weighted stock market return.

The interpretation of these variables is as follows:

(1) Counterparty risk is the risk that the seller of CDS cannot honor its commitment to the CDS buyer in the event of default. It will make CDS less valuable. The counterparty risk matters only if the default of the underlying firm and that of the CDS issuer occur at the same time. Since CDS are over-the-counter and it is hard to identify the seller and buyer of CDS protection (see Arora, Gandhi, and Longstaff, 2012), we employ a proxy for the counterparty risk measure. We

use the list of primary dealers designated by the Federal Reserve Bank of New York and construct a value-weighted stock index for these dealers. β^{i}_{cp} measures bond *i*'s underlying firm's counterparty risk as the regression coefficient of its stock return on the primary dealer's index stock return.

(2) β^{i}_{libor} measures bond *i*'s underlying firm's funding cost risk as the regression coefficient of its CDS spread change on the change in the Libor-OIS spread. The LIBOR-OIS spread partially indicates the uncollateralized funding cost of financial intermediaries. The co-movement measure represents the increase in the risk of basis trade when the funding cost widens at the same time that the basis becomes more negative.

(3) The collateralized funding cost is the repo spread (the difference between the 3-month general collateral repo rate minus the 3-month Treasury bill), which reflects a flight-to-quality liquidity component. β^{i}_{frepo} measures bond *i*'s underlying firm's market liquidity risk as the regression coefficient of its CDS spread change on the repo spread.

(4) Haircut is proxied by the collateral quality of the individual bond issued by the reference entity in a CDS contract. To do negative basis arbitrage, an arbitrageur needs to buy bonds that are funded via the repo market using the same bonds as collateral. The haircut imposed on the transaction causes the basis to become more negative. Since a haircut is not observed at the individual bond level, the collateral quality index based on firm characteristics is used to proxy for the contemporaneous and future expected haircuts related to the firm's bond. Specifically, a firm with more assets, more tangible assets, a higher rating, lower leverage, a lower CDS spread, and lower CDS volatility will tend to have bonds with higher collateral quality in cross-section.

(5) Transaction cost is proxied by three illiquidity measures. *Liq* refers to individual bond *i*'s illiquidity in terms of turnover. *Bliq* proxies for the individual bond's illiquidity exposure to the illiquidity of the entire bond market. *BLiqMkt* represents individual bond *i*'s liquidity exposure to the illiquidity of the entire financial market. The latter two measures are consistent with the analysis of Acharya and Pedersen (2005), who propose that arbitrageurs prefer negative basis trades for bonds that tend to have trading costs that co-vary less with bond market illiquidity and more with market returns.

The additional control variable β_{mkt}^{i} is employed to proxy for the other plausible neglected risk that might affect how a basis arbitrageur would allocate risk capital to the basis trade. This is a "market beta" factor to proxy for how the particular basis co-varies with the arbitrageur's portfolio.

The regression analysis is performed for the entire sample as well as for investment-grade (IG) and high-yield (HY) bonds separately. Like Bai and Collin-Dufresne (2014), we run separate regressions for the pre-crisis (from March 2003 through June 2007) and crisis periods (July 2007 through December 2008).

Table A.1. Cross-Sectional Regression of the CDS-Bond Basis on Risk Factors

This table reports the Fama-MacBeth (1973) cross-sectional regression results of the CDS-bond basis on the risk factors proposed by Bai and Collin-Dufresne (2014) on the daily data. We break the sample into a pre-crisis period from March 2003 through June 2007 and crisis period from July 2007 through December 2008. *Liq* is the illiquidity cost measured by the bond's turnover. *Bliq* measures the co-movement between a bond's illiquidity and the market liquidity as the regression coefficient of its bond turnover on the bond market turnover. *BliqMkt* measures the co-movement between a bond's illiquidity and the market return where the market return is measured by the CRSP value-weighted stock market return. *CP* measures an underlying entity's counterparty risk as the regression coefficient of its stock return on the primary dealer's index stock return. *Fund(repo)* measures an underlying entity's market liquidity risk as the regression coefficient of its CDS spread change on the repo spread, which is calculated as the 3-month general collateral repo rate minus the 3-month Treasury bill. *Fund(libor)* measures an underlying entity's funding cost risk as the regression coefficient of its CDS spread change on the change in the Libor-OIS spread. *Collateral* is an index measuring the collateral quality of the bond issued by each reference entity, consisting of firm size, leverage, rating, tangible ratio, CDS level, and CDS volatility. *Mkt* is the beta coefficient of a stock return with respect to the primary dealer's index stock return. All represents all corporate bonds. IG represents investment-grade bonds, and HY represents high-yield bonds. Numbers in brackets are the t-statistics. ***, **, and * denote significance at the 1%, 5%, 10% levels, respectively.

	Pre-crisis (Mar 2003 - June 2007)			Crisis Period (July 2007 - Dec 2008)		
	All	IG	HY	All	IG	HY
Liq	0.01***	0.01**	0.12***	-0.01	-0.02**	1.15
	[3.87]	[2.42]	[7.02]	[-0.83]	[-2.08]	[1.01]
Bliq	0.00	0.00	0.15***	0.00	-0.02***	-0.10
	[-0.24]	[-1.19]	[10.36]	[-0.29]	[-3.32]	[-0.40]
BliqMkt	0.36***	0.23***	-1.04***	5.31***	2.91***	7.95
	[5.77]	[5.24]	[-3.39]	[19.38]	[11.43]	[0.32]
CP	-0.06***	-0.23***	-0.10**	-0.06**	-0.06***	1.18***
	[-3.96]	[-22.23]	[-2.46]	[-2.47]	[-2.75]	[4.45]
Fund(repo)	0.21***	0.12***	0.98***	0.29***	-0.15***	2.37
	[13.18]	[8.41]	[15.74]	[5.78]	[-3.53]	[1.54]
Fund(libor)	-52.62***	-75.40***	-13.69***	16.08***	-6.34	-16.28
	[-20.45]	[-26.63]	[-11.72]	[7.03]	[-1.49]	[-0.56]
Collateral	0.08	-0.54***	0.66***	2.54***	4.32***	0.25
	[1.10]	[-9.12]	[6.13]	[12.90]	[11.10]	[0.07]
Mkt	-0.06***	0.01***	-0.16***	-0.08***	0.04***	-0.26***
	[-20.90]	[12.40]	[-24.67]	[-17.34]	[14.85]	[-2.81]
Intercept	-0.10***	-0.10***	-0.33***	-0.72***	-0.82***	-3.37***
	[-11.98]	[-12.94]	[-8.29]	[-21.50]	[-25.67]	[-7.21]
N	144,160	113,526	30,934	39,940	30,655	9,285
R^2	0.27	0.09	0.43	0.43	0.11	0.61

Table A.2. Robustness for Market Microstructure: Profitability of Residual Basis Sorted Portfolios

This table reports the average (*k*-day, *k=20, 40, 60*) abnormal returns of quintile corporate bond portfolios sorted on the residual basis for all bonds in the sample, as well as the IG and HY bonds separately, *after taking into account the market microstructure*. For each day *t*, basis portfolios are constructed by sorting the bonds into quintiles based on the residual basis, and their value-weighted abnormal returns from day *t+1* to day *t+k+1* are computed. Residual basis is the difference between the basis and the predicted component of basis by the model in Bai and Collin-Dufresne (2014). Basis is defined as the difference between the CDS spread and Z-spread. "Low-High" indicates the returns of zero-investment portfolios constructed by longing the lowest basis quintile portfolio and shorting the highest basis quintile portfolio. Numbers in brackets are the t-statistics. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

				k=20			
		Low	2	3	4	High	Low-High
All	abn. ret.	0.89***	0.84***	0.69***	0.60***	0.42***	0.47***
(N=169,213)	t-stat	[8.89]	[10.82]	[9.44]	[10.85]	[5.81]	[4.63]
IG	abn. ret.	1.02***	0.87***	0.75***	0.66***	0.43***	0.59***
(N=130,956)	t-stat	[10.62]	[10.77]	[10.95]	[11.63]	[8.02]	[6.57]
HY	abn. ret.	0.10	-0.24	-0.15	0.32	0.07	0.00
(N=38,257)	t-stat	[0.46]	[-0.87]	[-0.86]	[1.63]	[0.25]	[-0.01]
				k=40			
		Low	2	3	4	High	Low-High
All	abn. ret.	1.54***	1.55***	1.23***	0.99***	0.80***	0.74***
(N=127,196)	t-stat	[9.33]	[9.61]	[7.87]	[7.45]	[3.89]	[3.90]
IG	abn. ret.	1.79***	1.62***	1.44***	1.10***	0.87***	0.92***
(N=97,223)	t-stat	[9.84]	[9.67]	[10.69]	[8.20]	[7.01]	[5.64]
HY	abn. ret.	0.21	-0.39	-0.63	-0.07	-0.62	0.83
(N=29,973)	t-stat	[0.53]	[-0.84]	[-1.17]	[-0.14]	[-1.06]	[1.55]
				k=60			
		Low	2	3	4	High	Low-High
All	abn. ret.	2.03***	2.22***	1.78***	1.31***	0.87***	1.16***
(N=121,261)	t-stat	[6.25]	[9.00]	[7.13]	[5.67]	[2.46]	[3.83]
IG	abn. ret.	2.55***	2.43***	1.97***	1.57***	1.10***	1.46***
(N=92,651)	t-stat	[8.81]	[10.07]	[7.94]	[6.55]	[4.57]	[7.42]
HY	abn. ret.	0.23	-0.05	0.14	0.63	-0.51	0.74
(N=28,610)	t-stat	[0.44]	[-0.09]	[0.22]	[0.72]	[-0.44]	[0.67]

Table A.3. Robustness Tests for Subsamples

This table reports robustness tests for the predictive power of residual and predicted basis for future bond returns and CDS spreads from 2003 through 2008 for four subsamples based on credit ratings and time periods. *Basis* is the difference between CDS spread and Z-spread. $Basis_{predicted}$ is the predicted component of basis using the model in Bai and Collin-Dufresne (2014) and $Basis_{residual}$ is defined as ($Basis - Basis_{predicted}$). Panel A reports subsample tests for future bond returns for four subsamples. "Investment Grade Bonds in Pre-crisis Period" refers to the subsample of investment grade bonds from March 2003 through June 2007. "High Yield Bonds in Pre-crisis Period" refers to the subsample of high-yield bonds from the same period. "Investment Grade Bonds in Crisis Period" and "High Yield Bonds in Crisis Period" refer to the subsamples of investment grade and high yield bonds from July 2007 through December 2008. The dependent variable in Panel A is bond returns for day *t* to day *t+k* (*k*=20, 40, 60). The control variables are listed as the follows. *Bond Return* is the individual bond's lagged *k*-day excess return from day *t-k* to day *t*. *CDS Spread* is the CDS spread on day *t,* and *Δ(CDS Spread)* is the rate of CDS spread changes from day *t-k* to day *t*. *Rating* is a categorical variable ranging from 1 to 20 for all bonds (S&P rating AAA to CC). We use the S&P ratings whenever available, followed by Moody's and Fitch's ratings. *Coupon* is in percentage terms. *Issue size* is the natural logarithm of the issuance amount in billions. *Maturity* and *age* are in years. *Indliq* is the *k*-day cumulative turnover measured as the total trading volume divided by the total number outstanding. The dependent variable for Panel B is the change in CDS spread from day *t* to day *t+k*. Other control variables included are as follows. *Δ(CDSliq)* is the *k*-day change in the number of CDS dealers' quotes. *Stock return* is the rate of changes in stock prices within the past one month. *Δ(Volatility)* is the rate of change in stock volatility within the past one month, where stock volatility is defined as the standard deviation of daily stock returns measured in a 60-day window. *Δ(Leverage)* is the rate of change in market leverage within the past three months, where market leverage is measured by the book value of total debt divided by the market value of total assets. *Δ(Size)* is the rate of change in the logarithm of the market value of total assets within the past three months. *Δ(Profitability)* is the rate of change in net income divided by the market value of total assets within the past three months. *Δ(Cash)* is defined as the rate of change in cash ratio in the past three months. The cash ratio is defined as the ratio of cash and cash equivalent divided by the market value of total assets. The Newey-West t-statistics are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Residual Basis with Future Bond Returns

	Investment Grade Bonds in Pre-crisis Period (March 2003 to June 2007)								
	k=20			k=40			k=60		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
$Basis_{residual}$	-2.39***	-2.40***	-1.74***	-2.60***	-2.61***	-2.01***	-2.88***	-2.90***	-2.36***
	[-39.94]	[-39.88]	[-32.86]	[-29.08]	[-28.77]	[-20.51]	[-23.41]	[-23.05]	[-16.20]
$Basis_{predicted}$	-1.99***	-2.00***	-1.50***	-2.13***	-2.13***	-1.68***	-2.33***	-2.34***	-1.96***
	[-21.89]	[-21.75]	[-17.93]	[-16.39]	[-16.84]	[-12.70]	[-13.35]	[-13.42]	[-11.67]
Control Variables	YES	YES	YES	YES	YES	YES	YES	YES	YES
N	111,726	111,726	111,726	107,575	107,575	107,575	103,193	103,193	103,193
R^2	0.31	0.31	0.38	0.40	0.40	0.45	0.46	0.46	0.50

	High Yield Bonds in Pre-crisis Period (March 2003 to June 2007)								
	k=20			k=40			k=60		
	Model 10	Model 11	Model 12	Model 13	Model 14	Model 15	Model 16	Model 17	Model 18
$Basis_{residual}$	-1.24***	-1.30***	-0.99***	-1.63***	-1.65***	-1.45***	-1.87***	-1.86***	-1.75***
	[-14.61]	[-15.49]	[-13.22]	[-16.17]	[-15.68]	[-14.21]	[-15.23]	[-15.40]	[-13.09]
$Basis_{predicted}$	-1.04***	-1.12***	-0.80***	-1.39***	-1.39***	-1.20***	-1.58***	-1.59***	-1.46***
	[-9.29]	[-10.26]	[-7.76]	[-8.40]	[-7.94]	[-7.43]	[-7.28]	[-7.27]	[-6.22]
Control Variables	YES	YES	YES	YES	YES	YES	YES	YES	YES
N	30,289	30,289	30,289	29,335	29,335	29,335	26,268	26,268	26,268
R^2	0.31	0.32	0.36	0.40	0.41	0.44	0.44	0.45	0.46

	Investment Grade Bonds in Crisis Period (July 2007 to December 2008)								
	k=20			k=40			k=60		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
$Basis_{residual}$	-2.11***	-2.10***	-1.45***	-1.99***	-2.01***	-1.12***	-1.80***	-1.81***	-1.07***
	[-15.84]	[-15.30]	[-11.49]	[-7.91]	[-7.58]	[-4.57]	[-5.29]	[-4.95]	[-3.58]
$Basis_{predicted}$	-1.78***	-1.83***	-1.21***	-1.60***	-1.73***	-0.71*	-0.63	-0.69	0.07
	[-10.22]	[-10.10]	[-6.31]	[-4.53]	[-4.91]	[-1.75]	[-0.84]	[-0.89]	[0.10]
Control Variables	YES	YES	YES	YES	YES	YES	YES	YES	YES
N	29,759	29,759	29,759	26,729	26,729	26,729	24,054	24,054	24,054
R^2	0.25	0.26	0.32	0.29	0.30	0.35	0.31	0.31	0.34

	High Yield Bonds in Crisis Period (July 2007 to December 2008)								
	k=20			k=40			k=60		
	Model 10	Model 11	Model 12	Model 13	Model 14	Model 15	Model 16	Model 17	Model 18
$Basis_{residual}$	-0.89***	-0.89***	-0.56***	-1.03***	-1.07***	-0.65***	-1.10***	-1.13***	-0.87**
	[-6.78]	[-6.55]	[-5.37]	[-4.59]	[-4.63]	[-3.12]	[-2.62]	[-2.68]	[-2.26]
$Basis_{predicted}$	-1.07***	-1.06***	-0.69**	-1.14***	-1.14***	-0.78**	-0.91*	-0.94*	-0.68
	[-4.17]	[-4.36]	[-2.28]	[-2.84]	[-2.86]	[-2.00]	[-1.78]	[-1.74]	[-1.38]
Control Variables	YES	YES	YES	YES	YES	YES	YES	YES	YES
N	9,254	9,254	9,254	8,681	8,681	8,681	8,046	8,046	8,046
R^2	0.33	0.34	0.40	0.45	0.48	0.49	0.51	0.53	0.54

Panel B: Residual Basis with Future CDS Spread Change

	Investment Grade ΔCDS in Pre-crisis Period (March 2003 to June 2007)									Speculative Grade ΔCDS in Pre-crisis Period (March 2003 to June 2007)								
	k=20			k=40			k=60			k=20			k=40			k=60		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14	Model 15	Model 16	Model 17	Model 18
$Basis_{residual}$	-3.16***	-3.01***	-3.57***	-5.10***	-4.64***	-5.52***	-7.07***	-5.96***	-7.38***	-1.53***	-1.45***	-1.37***	-1.54**	-1.24**	-1.61**	-0.75	-0.44	-0.78
	[-7.69]	[-6.79]	[-7.56]	[-6.27]	[-5.31]	[-6.64]	[-6.10]	[-4.27]	[-6.85]	[-4.92]	[-5.19]	[-4.09]	[-2.27]	[-2.06]	[-2.13]	[-0.70]	[-0.46]	[-0.69]
$Basis_{predicted}$	2.95	4.09	2.74	4.94	6.11	4.65	6.01	8.64	5.19	-0.35	-0.50	-0.19	0.94	1.38	1.06	4.42	4.26	4.38
	[1.02]	[1.41]	[0.95]	[0.87]	[1.06]	[0.82]	[0.72]	[0.98]	[0.62]	[-0.45]	[-0.65]	[-0.25]	[0.40]	[0.53]	[0.48]	[1.16]	[1.11]	[1.19]
Control Variables	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
N	107,751	107,751	107,751	103,863	103,863	103,863	99,756	99,756	99,756	29,983	29,983	29,983	28,973	28,973	28,973	27,669	27,669	27,669
R^2	0.15	0.20	0.16	0.18	0.22	0.19	0.20	0.23	0.21	0.33	0.38	0.33	0.34	0.39	0.34	0.35	0.40	0.35

	Investment Grade ΔCDS in Crisis Period (July 2007 to December 2008)									Speculative Grade CDS in Crisis Period (July 2007 to December 2008)								
	k=20			k=40			k=60			k=20			k=40			k=60		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14	Model 15	Model 16	Model 17	Model 18
$Basis_{residual}$	-0.81	-0.65	-1.30*	-0.82	-0.34	-1.13	-0.16	-0.12	1.03	-1.30***	-1.40***	-1.40***	-1.66**	-1.38**	-2.11**	-2.52**	-2.67**	-3.17**
	[-1.46]	[-1.22]	[-1.67]	[-0.55]	[-0.21]	[-0.58]	[-0.06]	[-0.06]	[0.25]	[-3.83]	[-3.69]	[-3.79]	[-2.34]	[-1.99]	[-2.38]	[-2.04]	[-2.06]	[-2.11]
$Basis_{predicted}$	-2.73	-2.80	-3.05	-5.60	-4.35	-6.05	-5.48	-4.33	-4.20	-0.04	-0.39	-0.31	0.17	-0.02	-0.33	1.06	1.39	0.32
	[-0.98]	[-1.06]	[-1.06]	[-0.97]	[-0.77]	[-0.97]	[-0.69]	[-0.56]	[-0.47]	[-0.05]	[-0.46]	[-0.37]	[0.07]	[-0.01]	[-0.15]	[0.25]	[0.33]	[0.07]
Control Variables	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
N	29,744	29,744	29,744	26,719	26,719	26,719	24,041	24,041	24,041	9,102	9,102	9,102	8,578	8,578	8,578	7,979	7,979	7,979
R^2	0.17	0.19	0.17	0.18	0.21	0.18	0.17	0.20	0.18	0.42	0.47	0.43	0.44	0.48	0.44	0.45	0.51	0.46

Table A.4. Robustness for Market Microstructure: Predictability for Bond Returns for IG and HY Bonds

This table reports robustness tests for the predictive power of residual and predicted basis for future bond returns from 2003 through 2008 for two subsamples based on credit ratings such as investment grade (IG) and speculative grade (HY), *after taking into account the market microstructure*. *Basis* is defined as (CDS spread – Z-spread) on day *t* for the individual bond. $Basis_{predicted}$ is the predicted component of *Basis* by the model in Bai and Collin-Dufresne (2014), and $Basis_{residual}$ is computed as ($Basis - Basis_{predicted}$). The dependent variable is the individual bond's *k*-day excess return from day *t+1* to day *t+k+1*. Other control variables are given as follows. *CDS Spread* is the CDS spread on day *t,* and *Δ(CDS Spread)* is the rate of CDS spread changes from day *t–k* to day *t*. *Rating* is a categorical variable ranging from 1 to 20 for all bonds (S&P rating AAA to CC). We use the S&P ratings whenever available, followed by Moody's and Fitch's ratings. *Coupon* is in percentage terms. *Issue size* is the natural logarithm of the issuance amount in billions. *Maturity* and *age* are in years. *Indliq* is the *k*-day cumulative turnover measured as the total trading volume divided by the total number outstanding. The Newey-West t-statistics are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Investment Grade Bonds								
	k=20			**k=40**			**k=60**		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
$Basis_{residual}$	-0.25***	-0.23***	-0.24***	-0.31***	-0.29***	-0.24**	-0.44***	-0.43***	-0.39***
	[-7.20]	[-6.89]	[-5.83]	[-3.73]	[-3.55]	[-2.37]	[-3.24]	[-3.08]	[-2.58]
$Basis_{predicted}$	-0.20***	-0.19***	-0.21***	-0.12	-0.10	-0.07	-0.07	-0.04	-0.05
	[-2.99]	[-2.71]	[-3.07]	[-0.89]	[-0.71]	[-0.43]	[-0.23]	[-0.15]	[-0.16]
	Speculative Grade Bonds								
	k=20			**k=40**			**k=60**		
	Model 10	Model 11	Model 12	Model 13	Model 14	Model 15	Model 16	Model 17	Model 18
$Basis_{residual}$	-0.21***	-0.24***	-0.24***	-0.46***	-0.47***	-0.48***	-0.58***	-0.52***	-0.64***
	[-3.63]	[-4.35]	[-4.03]	[-4.63]	[-4.96]	[-4.40]	[-4.16]	[-3.71]	[-4.47]
$Basis_{predicted}$	-0.22**	-0.24**	-0.23**	-0.44**	-0.37**	-0.40**	-0.49**	-0.42*	-0.54**
	[-2.24]	[-2.58]	[-2.45]	[-2.57]	[-2.03]	[-2.30]	[-2.10]	[-1.68]	[-2.24]

Table A.5. Robustness for Market Microstructure: Predictability for Bond Returns for Pre-crisis and Crisis Periods

This table reports robustness tests for the predictive power of residual and predicted basis for future bond returns from 2003 through 2008 for two subsamples based on the financial crisis *after taking into account market microstructure*. "Pre-crisis Period" refers to the subsample from March 2003 through June 2007. "Crisis Period" refers to the subsample from July 2007 through December 2008. *Basis* is defined as (CDS spread – Z-spread) on day *t* for the individual bond. $Basis_{predicted}$ is the predicted component of *Basis* by the model in Bai and Collin-Dufresne (2014), and $Basis_{residual}$ is computed as ($Basis - Basis_{predicted}$). The dependent variable is the individual bond's *k*-day excess return from day *t+1* to day *t+k+1*. Other control variable are given as follows. *CDS Spread* is the CDS spread on day *t,* and *Δ(CDS Spread)* is the rate of CDS spread changes from day *t-k* to day *t*. *Rating* is a categorical variable ranging from 1 to 20 for all bonds (S&P rating AAA to CC). We use the S&P ratings whenever available, followed by Moody's and Fitch's ratings. *Coupon* is in percentage terms. *Issue size* is the natural logarithm of the issuance amount in billions. *Maturity* and *age* are in years. *Indliq* is the *k*-day cumulative turnover measured as the total trading volume divided by the total number outstanding. The Newey-West t-statistics are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Pre-crisis Period								
	k=20			k=40			k=60		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Basis$_{residual}$	-0.22***	-0.22***	-0.26***	-0.36***	-0.36***	-0.39***	-0.56***	-0.55***	-0.56***
	[-5.79]	[-5.89]	[-6.85]	[-5.35]	[-5.37]	[-4.79]	[-6.11]	[-6.18]	[-5.20]
Basis$_{predicted}$	-0.09	-0.09	-0.15*	-0.17	-0.16	-0.23	-0.23	-0.25	-0.31
	[-0.94]	[-0.93]	[-1.73]	[-0.86]	[-0.84]	[-1.35]	[-0.87]	[-0.97]	[-1.36]
	Crisis Period								
	k=20			k=40			k=60		
	Model 10	Model 11	Model 12	Model 13	Model 14	Model 15	Model 16	Model 17	Model 18
Basis$_{residual}$	-0.15**	-0.13*	-0.12	-0.21	-0.2	-0.09	-0.07	-0.06	-0.14
	[-2.02]	[-1.88]	[-1.47]	[-1.13]	[-1.08]	[-0.42]	[-0.25]	[-0.20]	[-0.42]
Basis$_{predicted}$	-0.17	-0.16	-0.12	-0.32	-0.34	-0.2	-0.22	-0.23	-0.26
	[-1.16]	[-1.10]	[-0.82]	[-0.76]	[-0.84]	[-0.47]	[-0.29]	[-0.30]	[-0.33]

Table A.6. Robustness for Market Microstructure: Predictability for Bond Returns for Subsamples

This table reports robustness tests for the predictive power of residual and predicted basis for future bond returns from 2003 through 2008 for four subsamples based on credit ratings and time periods *after taking into account the market microstructure*. *Basis* is the difference between CDS spread and Z-spread. $Basis_{predicted}$ is the predicted component of basis using the model in Bai and Collin-Dufresne (2014), and $Basis_{residual}$ is defined as ($Basis - Basis_{predicted}$). "Investment Grade Bonds in Pre-crisis Period" refers to the subsample of investment-grade bonds from March 2003 through June 2007. "High Yield Bonds in Pre-crisis Period" refers to the subsample of high-yield bonds from the same period. "Investment-Grade Bonds in Crisis Period" and "High-Yield Bonds in Crisis Period" refer to the subsamples of investment-grade and high-yield bonds from July 2007 through December 2008. The dependent variable is bond returns for day $t+1$ to day $t+k+1$ (k=20, 40, 60). Other control variables are listed as the follows. *Bond Return* is the individual bond's lagged k-day excess return from day $t-k$ to day t. *CDS Spread* is the CDS spread on day t, and Δ*(CDS Spread)* is the rate of CDS spread changes from day $t-k$ to day t. *Rating* is a categorical variable ranging from 1 to 20 for all bonds (S&P rating AAA to CC). We use the S&P ratings whenever available, followed by Moody's and Fitch's ratings. *Coupon* is in percentage terms. *Issue size* is the natural logarithm of the issuance amount in billions. *Maturity* and *age* are in years. *Indliq* is the k-day cumulative turnover measured as the total trading volume divided by the total number outstanding. The Newey-West t-statistics are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Investment Grade Bonds in Pre-crisis Period (March 2003 to June 2007)

	k=20			k=40			k=60		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Basis$_{residual}$	-0.27***	-0.27***	-0.28***	-0.39***	-0.38***	-0.37***	-0.62***	-0.62***	-0.59***
	[-8.55]	[-8.47]	[-7.38]	[-5.31]	[-5.36]	[-3.76]	[-5.41]	[-5.26]	[-4.03]
Basis$_{predicted}$	-0.25***	-0.24***	-0.26***	-0.30**	-0.26**	-0.29**	-0.47**	-0.44**	-0.46**
	[-3.51]	[-3.43]	[-3.91]	[-2.32]	[-1.97]	[-2.13]	[-2.40]	[-2.18]	[-2.13]

Investment Grade Bonds in Crisis Period (July 2007 to December 2008)

	k=20			k=40			k=60		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Basis$_{residual}$	-0.17	-0.13	-0.12	-0.01	0.02	0.21	0.26	0.29	0.34
	[-1.62]	[-1.31]	[-0.96]	[-0.04]	[0.09]	[0.90]	[1.04]	[0.99]	[1.45]
Basis$_{predicted}$	-0.07	-0.02	-0.05	0.49	0.48	0.72*	1.46*	1.46*	1.52*
	[-0.37]	[-0.11]	[-0.24]	[1.45]	[1.53]	[1.74]	[1.74]	[1.74]	[1.88]

High Yield Bonds in Pre-crisis Period (March 2003 to June 2007)

	k=20			k=40			k=60		
	Model 10	Model 11	Model 12	Model 13	Model 14	Model 15	Model 16	Model 17	Model 18
Basis$_{residual}$	-0.27***	-0.31***	-0.31***	-0.57***	-0.55***	-0.62***	-0.75***	-0.70***	-0.80***
	[-4.06]	[-4.94]	[-4.71]	[-7.09]	[-6.37]	[-6.99]	[-8.00]	[-6.95]	[-7.50]
Basis$_{predicted}$	-0.16	-0.21**	-0.19**	-0.39**	-0.33*	-0.41**	-0.61**	-0.56**	-0.66***
	[-1.57]	[-2.12]	[-2.14]	[-2.17]	[-1.79]	[-2.41]	[-2.55]	[-2.31]	[-2.69]

High Yield Bonds in Crisis Period (July 2007 to December 2008)

	k=20			k=40			k=60		
	Model 10	Model 11	Model 12	Model 13	Model 14	Model 15	Model 16	Model 17	Model 18
Basis$_{residual}$	-0.05	-0.07	-0.07	-0.19	-0.28	-0.13	-0.17	-0.08	-0.26
	[-0.61]	[-0.80]	[-0.72]	[-0.80]	[-1.26]	[-0.54]	[-0.58]	[-0.28]	[-0.81]
Basis$_{predicted}$	-0.36	-0.33	-0.32	-0.56	-0.47	-0.39	-0.19	-0.07	-0.25
	[-1.63]	[-1.51]	[-1.37]	[-1.46]	[-1.09]	[-0.88]	[-0.37]	[-0.12]	[-0.45]

Table A.7. Robustness Tests for Fama-Macbeth Regression

This table presents the estimated coefficients of Fama-MacBeth (1973) regressions of bond returns on bond characteristics and risk factor loading as robustness tests. Without specification, the bond return is future return in 20 days. Panel A reports the regression of 18 portfolios sorted on credit ratings (IG and HY), level of residual basis (H, M and L), and the loadings on LMH factors (H, M and L). Panel B reports the regression on individual bond returns. Model 1 replaces the Amihud liquidity measure with Pástor and Stambaugh (2003) liquidity measures. Model 2 reports the results from 40-day ahead bond returns as the dependent variable. Model 3 reports the results from using 60-day ahead future bond returns. Model 4 reports the results for "Pre-crisis period" from March 2003 through June 2007. Model 5 reports the results for "Crisis period" from July 2007 through December 2008. Model 6 reports the results for investment-grade bonds. Model 7 reports the results for speculative-grade bonds. *Rating* is a categorical variable ranging from 1 to 20 for all bonds (S&P rating AAA to CC). *Coupon* is the coupon rate in percent. *Size* is the natural logarithm of the issuance amount in billions. *Age* is in years. *Indliq* is the 20-day cumulative turnover measured as the total trading volume divided by the total number outstanding. β_{MKT}, β_{SMB}, β_{HML}, β_{DEF}, β_{TERM}, β_{LIQ}, β_{FLIQ} and β_{LMH} is betas of MKT, SMB, HML, DEF, TERM, LIQ, FLIQ, and LMH respectively. *MKT*, *SMB*, and *HML* are Fama-French (1993) three factors. *DEF* is the difference between the daily return of the Lehman investment-grade bond index return from Datastream and the daily 10-year-to-maturity government bond return from CRSP. *TERM* is the difference between the daily return of the 10-year-to-maturity government bond index and the daily T-bill return. *LIQ* is the market liquidity risk factor in Amihud (2002). *FLIQ* is the funding liquidity risk factor proxied by TED, the average of the 3-month uncollateralized LIBOR rate minus the 3-month T-bill rate. The basis factor, *LMH* (Low minus High), is defined as the return differential between the low residual basis portfolio and the high residual basis portfolio, i.e., (IG/L+HY/L)/2 – (IG/H+HY/H)/2. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Portfolio-level regression

	Dependent Variable: Bond Return													
	$Basis_{residual}$	Rating	Coupon	Size	Age	Indliq	β_{MKT}	β_{SMB}	β_{HML}	β_{DEF}	β_{TERM}	β_{LIQ}	β_{FLIQ}	β_{LMH}
Model 1	-0.76***	-0.07*	0.13*	0.08	0.03	4.10*	1.74	0.52	0.65	0.29	0.49	-0.01	0.04	0.00
	[-4.81]	[-1.73]	[1.68]	[0.62]	[0.37]	[1.74]	[0.89]	[0.90]	[1.17]	[0.47]	[0.77]	[-0.22]	[0.32]	[-0.01]
Model 2	-0.90***	-0.07	0.00	0.16	0.17*	5.65	-2.97*	0.26	0.26	-0.73	1.01	-0.50	0.16	-0.39
	[-5.15]	[-0.81]	[-0.03]	[0.93]	[1.69]	[1.24]	[-1.68]	[0.32]	[0.24]	[-0.69]	[1.16]	[-1.08]	[1.2]	[-1.41]
Model 3	-0.94***	-0.20	0.28*	0.14	-0.05	3.21	-2.22	0.04	2.23**	-1.57	1.71**	-0.08	0.15	-0.42
	[-4.23]	[-1.51]	[1.74]	[0.71]	[-0.31]	[1.54]	[-1.14]	[0.04]	[2.58]	[-1.40]	[2.14]	[-0.17]	[1.51]	[-1.31]
Model 4	-0.67***	0.05	0.04	0.06	0.11	1.48	0.01	0.00	0.48	0.15	0.48	-0.10	-0.03	-0.17
	[-3.07]	[1.49]	[0.49]	[0.56]	[1.48]	[0.87]	[0.01]	[0.01]	[0.99]	[0.49]	[0.87]	[-0.22]	[-1.01]	[-0.98]
Model 5	-0.90***	-0.12*	-0.10	0.01	0.00	-0.20	2.23	1.77**	-0.81	0.72	1.18	0.24	0.19	0.08
	[-4.85]	[-1.83]	[-0.59]	[0.03]	[0.04]	[-0.05]	[0.69]	[2.08]	[-0.78]	[0.54]	[0.95]	[0.36]	[0.69]	[0.25]

Panel B: Bond-level regression

	Dependent Variable: Bond Return													
	$Basis_{residual}$	**Rating**	**Coupon**	**Size**	**Age**	**Indliq**	**β_{MKT}**	**β_{SMB}**	**β_{HML}**	**β_{DEF}**	**β_{TERM}**	**β_{LIQ}**	**β_{FLIQ}**	**β_{LMH}**
Model 1	-0.77***	-0.04	-0.01	0.04	-0.03	0.90	-0.46	-0.22	-0.15	-0.40	-0.31***	-0.02	0.14**	-0.24**
	[-11.12]	[-1.46]	[-0.46]	[0.85]	[-1.15]	[1.41]	[-0.66]	[-0.82]	[-0.47]	[-1.12]	[-7.62]	[-0.84]	[2.02]	[-2.02]
Model 2	-0.73***	-0.02	-0.01	0.07	-0.01	1.04*	-3.17*	-0.17	-0.33	-1.48	-0.38***	-0.34	0.17	-0.42*
	[-6.34]	[-0.52]	[-0.55]	[1.06]	[-0.15]	[1.96]	[-1.92]	[-0.22]	[-0.45]	[-1.54]	[-9.68]	[-1.06]	[1.61]	[-1.70]
Model 3	-0.63***	0.00	0.03	0.08	-0.09	1.10	-4.27*	0.31	0.07	-2.45*	-0.41***	-0.42	0.14	-0.62**
	[-3.98]	[-0.05]	[0.68]	[0.92]	[-0.91]	[1.27]	[-1.75]	[0.32]	[0.08]	[-1.71]	[-5.22]	[-1.20]	[1.44]	[-2.02]
Model 4	-0.69***	0.05***	-0.03	0.00	0.04*	0.48	-0.01	-0.44*	-0.02	-0.10	-0.24***	0.00	0.01	-0.40**
	[-6.00]	[3.84]	[-1.57]	[0.11]	[1.92]	[1.07]	[-0.03]	[-1.93]	[-0.11]	[-0.84]	[-5.74]	[-0.04]	[0.94]	[-2.47]
Model 5	-0.87***	-0.11***	0.00	0.07	-0.09**	1.33	-1.49	0.00	-0.24	-0.86	-0.43***	-0.41	0.26*	-0.16
	[-13.11]	[-2.84]	[0.11]	[0.93]	[-2.52]	[1.15]	[-1.08]	[0.00]	[-0.40]	[-1.24]	[-6.56]	[-0.86]	[1.87]	[-0.88]
Model 6	-1.61***	-0.11***	-0.09***	0.11***	-0.04**	0.78*	-1.50*	-0.42	-0.07	-0.69*	-0.31***	-0.33	0.17**	-0.10
	[-20.87]	[-4.46]	[-4.33]	[3.37]	[-1.99]	[1.86]	[-1.83]	[-1.35]	[-0.19]	[-1.80]	[-8.10]	[-1.25]	[2.04]	[-0.84]
Model 7	-0.79***	-0.03	-0.01	0.04	-0.03	0.93	-0.79	-0.21	-0.14	-0.50	-0.34***	-0.22	0.15*	-0.28**
	[-11.65]	[-1.39]	[-0.51]	[0.91]	[-1.27]	[1.42]	[-1.03]	[-0.67]	[-0.42]	[-1.32]	[-7.79]	[-0.83]	[1.86]	[-2.18]