FRBSF ECONOMIC LETTER

Number 2008-10, March 14, 2008

The Corporate Bond Credit Spread Puzzle

As of the end of the fourth quarter of 2006 the outstanding notional amount of U.S. corporate bonds totaled $8.2 trillion, the third largest asset class after equities and mortgage-backed securities in the U.S. Investors in the corporate bond market range from private individuals to banks and other institutional investors such as mutual funds and life insurance companies.

A thorough understanding of the primary factors determining the changes in corporate bond yields is important for proper risk management of corporate bond portfolios. It also is useful to the conduct of monetary policy since developments in the corporate bond market may provide a timely and forward-looking measure of the general business climate as opposed to statistical releases that are inherently backward looking.

It is common to view interest on a corporate bond as reflecting the risk-free, longer-term interest rate, such as that on a 10-year Treasury bond, plus a spread related to the credit risk of the corporation issuing the bond. However, empirical analysis of the determinants of corporate bond rates has turned out to be more demanding than it appears on the surface, as suggested by the analysis by Krainer (2004). This has led researchers to talk about a *credit spread puzzle*. In this *Economic Letter* we will first detail the evidence for the existence of such a credit spread puzzle. In a second step we will take a closer look at some of the pieces that go into explaining the puzzle.

The credit spread puzzle

In order to analyze risk conditions in the corporate bond market, it is not enough to look only at the yields, because they are susceptible to the fluctuations in the general bond market. Therefore, researchers as well as market practitioners use the credit spread. The credit spread typically is defined as the component of corporate bond yields that is above and beyond the yield of comparable default-free Treasury bonds—this equals the "excess" interest rate that would be earned if the corporation does not default and the investor holds the bond to maturity.

Given the large idiosyncratic variation across firms in different business sectors and of different credit quality, analysis of credit spreads focuses primarily on the systematic components common to all firms in the economy. In principle, this looks like a straightforward exercise. Observe the yield on a large number of corporate bonds and deduct the corresponding default-free interest rate component. The resulting credit spreads are supposed to reflect the financial health of the firms that issued the corporate bonds. The logic behind this supposition is that, in a world without distortion from factors such as transactions costs and taxes, the only rationale for credit spreads to exist would be to compensate for the probability of default and the size of the ensuing loss. Thus, the systematic components in corporate bond credit spreads should all be factors that reflect the financial conditions of firms in general.

In practice, however, empirical researchers have only been able to explain less than half of the variation in credit spreads, and therein lies the *credit spread puzzle.* For example, Duffie, Saita, and Wang (2007) present and estimate a dynamic model for the default probability of 2,770 U.S. industrial firms. They find that, in addition to a set of firm-specific factors, two market-based factors—the 3-month Treasury bill rate and the 12-month trailing return on the S&P 500 index—have significant explanatory power in predicting the default probability of the firms in their sample. These results suggest that, if credit spreads are primarily linked to default risk, the two market-based factors should be the only common factors in credit spreads on corporate bonds.

Two studies explore this issue, one by Duffee (1998) and the other by Collin-Dufresne, Goldstein, and Martin (2001). Based on a large sample of noncallable corporate bonds, Duffee (1998) finds that for most of the rating and maturity combinations considered, a little less than 20% of the variation in the average credit spread can be explained solely by the level and slope of the Treasury yield curve.

Collin-Dufresne et al. (2001) study the credit spread changes for 688 different corporate bonds. They control for variables that affect the likelihood of a firm defaulting such as leverage ratio and asset volatility in addition to controlling for the effects of changes in short- and long-term Treasury bond yields and the return on the S&P 500 index. However, they are able to explain only about 25% of the variation in the credit spread changes across the 688 different bonds. More surprisingly, the residuals from their firm-specific regressions are highly correlated across all bonds independent of their rating and maturity. In fact, based on principal component analysis of the residuals, they find that as much as 75% of that variation can be explained by a single, common factor.

In explaining this puzzle researchers have turned their attention to non-default related factors that would be common to the credit spreads of most firms in the economy. One such factor is the tax difference between interest earned on corporate and Treasury bonds. Another factor is the difference in liquidity between corporate and Treasury bond markets. The question is whether they can account for the puzzle.

Tax effects

Corporate bonds are at a tax disadvantage relative to Treasury bonds in that the interest earned is taxed at the federal and state levels, whereas interest income earned on Treasury bonds is only taxed at the federal level. Thus, in principle, the yield on all corporate bonds should be upward biased by this tax disadvantage in order to balance the after-tax return across the two classes of bonds.

There are two major arguments going against the significance of this tax effect. First, the marginal investor in the corporate bond market is likely to be a bank, an institutional investor or another legal entity for which there is no difference in the tax treatment of the return earned on corporate and Treasury bonds. Second, major changes in tax laws are infrequent, so they are unlikely to explain the frequent, large swings in bond spreads.

Indeed, this is the finding in the study by Elton, Gruber, Agrawal, and Mann (2001). They investigate what portion of the changes in corporate bond credit spreads can be explained by a tax effect, while controlling for the part of the credit spread that is compensation for expected default losses. They find that imposing an effective state tax rate of 4% maximizes the part of the credit spread changes that can be explained by their model. However, this still leaves more than half of the variation in credit spreads unexplained.

Combined with the results from Collin-Dufresne et al. (2001), who could only explain about 25% of the credit spread variation when they included the common stock and Treasury bond factors, it follows that tax effects can only explain a fraction of the credit spread puzzle. Furthermore, Elton et al. (2001) demonstrate that the unexplained residuals likely represent compensation for some other dimension of risk since they are correlated with the factors explaining excess returns in the stock market. One such key risk premium could be a liquidity risk premium.

Liquidity risk

While corporate bonds are traded, the volume of transactions is far less than for Treasury securities. Moreover, the information content of bond prices (prices move inversely with yields) tends to be lower for less actively traded securities. Since the high liquidity is an attractive dimension of a security, investors demand additional compensation for holding securities that are less liquid and therefore more costly to sell. For corporate bonds, that compensation for liquidity risk shows up in higher interest rate spreads over otherwise comparable Treasury bonds.

Houweling, Mentink, and Vorst (2005) analyze the effect of liquidity risk on corporate bond credit spreads based on a sample of 999 investment-grade corporate bonds. In their estimations they control for two common factors, the excess return from the stock market and the excess return of long-term corporate bonds over long-term Treasury bonds, in addition to the rating and maturity of each bond. They find that liquidity risk is priced into credit spreads and explains a significant portion of observed credit spreads. The size of the liquidity premium is determined by the size of the bond issuance, the yield volatility, and the age of the bond. They also find that the liquidity risk premium is time-varying.

As Houweling et al. (2005) do not include tax effects in their analysis, their study leaves open the question whether tax effects combined with liquidity effects can explain the credit spread puzzle. The paper by Driessen (2005) takes on that task.

The still missing piece

Based on a sample of corporate bonds issued by 104 U.S. industrial firms, Driessen (2005) makes a carefully orchestrated estimation in which he takes all the factors mentioned so far into consideration.

First, he estimates the level and slope factor from the Treasury bond market motivated by the evidence in Duffee (1998). Second, he estimates a time-varying liquidity risk premium factor as deemed appropriate by the results in Houweling et al. (2005). Third, he includes an effective state tax effect of 4.875%, building on the insights provided by Elton et al. (2001). Fourth, he estimates two credit risk factors common to all 104 firms in his sample in order to capture the commonality observed by Collin-Dufresne et al. (2001). Finally, he estimates a default risk factor for each of the 104 firms in order to control for any firm-specific factors.

Despite this careful setup there is still about one-third of the credit spread for the average BBB-rated firm that is not explained by Driessen's model. He refers to this missing piece as a large risk premium possibly caused by a tendency for firms to default in waves. This is a risk that is difficult to eliminate by diversification and therefore investors could require a premium to be willing to carry it.

A much debated issue, in particular given the recent turmoil in the global financial markets, is to what extent changes in the market price of risk or changes in investor risk preferences are part of the puzzle. However, as any such variation impacts the prices of all assets, the common factors from the stock and bond market are likely to control for these effects. Therefore, this explanation is not expected to be able to account for the missing piece.

Conclusion

Movements in corporate bond spreads are important to many investors and potentially informative forward-looking metrics of market sentiment. Extracting the information from movements in corporate bond spreads, however, is not always straightforward. The studies reviewed here show that more than half of the variation in corporate bond credit spreads is not related to the financial health of the issuing firm, but rather reflects effects such as compensation for liquidity risk, which can vary over time, and to some extent the tax treatment of corporate bonds. Thus, using corporate bond spreads to derive conclusions about the general business climate requires a very demanding decomposition of credit spreads into their separate components. Moreover, while the research reviewed here has been able to contribute much to our understanding of the composition of credit spreads on corporate bonds, there are still some significant pieces missing before the credit spread puzzle can be declared solved.

Jens Christensen
Economist

References

Collin-Dufresne, Pierre, Robert S. Goldstein, and J. Spencer Martin. 2001. "The Determinants of Credit Spread Changes." *Journal of Finance* 56(6) (December) pp. 2,177–2,207.

Driessen, Joost. 2005. "Is Default Event Risk Priced in Corporate Bonds?" *Review of Financial Studies* 18(1) (January) pp. 165–195.

Duffee, Gregory R. 1998. "The Relation between Treasury Yields and Corporate Bond Yield Spreads." *Journal of Finance* 53(6) (December) pp. 2,225–2,241.

Duffie, Darrell, Leandro Saita, and Ke Wang. 2007. "Multi-period Corporate Default Prediction with Stochastic Covariates." *Journal of Financial Economics* 83, pp. 635–665.

Elton, Edwin J., Martin J. Gruber, Deepak Agrawal, and Christopher Mann. 2001. "Explaining the Rate Spread on Corporate Bonds." *Journal of Finance* 56(1) (February) pp. 247–277.

Houweling, Patrick, Albert Mentink, and Ton Vorst. 2005. "Comparing Possible Proxies of Corporate Bond Liquidity." *Journal of Banking and Finance* 29, pp. 1,331–1,358.

Krainer, John. 2004. "What Determines the Credit Spread?" *FRBSF Economic Letter* 2004-36 (December 10). http://www.frbsf.org/publications/economics/letter/2004/el2004-36.html

ECONOMIC RESEARCH
FEDERAL RESERVE BANK
OF SAN FRANCISCO

P.O. Box 7702
San Francisco, CA 94120

Address Service Requested

Index to Recent Issues of *FRBSF Economic Letter*

DATE	NUMBER	TITLE	AUTHOR
8/31	07-25	Changing Productivity Trends	Trehan
9/14	07-26-27	Recent Financial Developments and the U.S. Economic Outlook	Yellen
9/21	07-28	Changes in Income Inequality across the U.S.	Regev/Wilson
9/28	07-29	Internal Risk Models and the Estimation of Default Probabilities	Christensen
10/5	07-30	Relative Comparisons and Economics: Empirical Evidence	Daly/Wilson
10/19	07-31	Corporate Access to External Financing	Lopez
10/26	07-32	Asset Price Bubbles	Lansing
11/2	07-33	Labor Force Participation and the Prospects for U.S. Growth	Daly/Regev
11/23	07-34	Financial Globalization and Monetary Policy	Spiegel
11/30	07-35	Fixing the New Keynesian Phillips Curve	Dennis
12/7	07-36-37	The U.S. Economy and Monetary Policy	Yellen
12/14	07-38	Sovereign Wealth Funds: Stumbling Blocks or Stepping Stones...?	Aizenman/Glick
1/18	08-01	Publishing FOMC Economic Forecasts	Rudebusch
1/25	08-02	Publishing Central Bank Interest Rate Forecasts	Rudebusch
2/1	08-03	2007 Annual Pacific Basin Conference: Summary	Glick
2/8	08-04-05	Prospects for the Economy in 2008	Yellen
2/15	08-06	Recent Trends in Economic Volatility: Conference Summary	Notzon/Wilson
2/22	08-07	Economic Conditions in Singapore and Vietnam: A Monetary...	Yellen
2/29	08-08	The Economics of Private Equity Investments: Symposium Summary	Lopez
3/7	08-09	Assessing Employment Growth in 2007	Regev

Opinions expressed in the *Economic Letter* do not necessarily reflect the views of the management of the Federal Reserve Bank of San Francisco or of the Board of Governors of the Federal Reserve System. This publication is edited by Judith Goff, with the assistance of Anita Todd. Permission to reprint portions of articles or whole articles must be obtained in writing. Permission to photocopy is unrestricted. Please send editorial comments and requests for subscriptions, back copies, address changes, and reprint permission to: Public Information Department, Federal Reserve Bank of San Francisco, P.O. Box 7702, San Francisco, CA 94120, phone (415) 974-2163, fax (415) 974-3341, e-mail sf.pubs@sf.frb.org. **The *Economic Letter* and other publications and information are available on our website, http://www.frbsf.org.**