Credit Spreads and Real Activity

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Central Question

What is the relationship between conditions in credit markets and the real economy?

- FOMC statement, April 30, 2008: “Financial markets remain under considerable stress, and tight credit conditions [...] are likely to weigh on economic growth over the next few quarters.”

- Vice Chairman Kohn, May 20, 2008: “[...] the tightening of financial conditions as a result of stresses in financial markets has been an important factor in the recent slowdown of the U.S. economy.”
Specifically, the questions this paper addresses are:

- Do credit spreads forecast future GDP growth?
- What drives the predictive content of credit spreads?
- Is it possible to link the forecasting power to conditions in the credit markets?
In this paper, I

• build a macro-finance term structure model

• jointly model the dynamics of credit spreads, Treasury yields and macro variables

• verify the predictive power of credit spreads for GDP growth

• identify drivers of credit spreads and the sources of the predictive power

• relate factors in the model to credit conditions
Main Results

- Credit spreads across the whole term structure contain information to predict future GDP growth.

- Predictability has two sources:
  - History of GDP growth and inflation contribute to predictive power at short horizons.
  - “Credit factor”, which is independent of the macro variables is most important contributor to forecasting power.

- Credit factor can be interpreted as a proxy for credit conditions.

- Results are consistent with the presence of a transmission channel from borrowing conditions to the economy.
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• Quarterly CPI and real GDP growth rates (FRED)

• Unsmoothed zero-coupon Treasury yields (maturities 3m to 10y) starting in 1971 (provided by Rob Bliss)

• Zero-coupon corporate bond yields (AAA to B) for the whole term structure (maturities 3m to 10y) starting in 1992 (Bloomberg)
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Credit Spread Regressions

Regress future GDP growth for horizon $k$ quarters on credit spreads for rating class $i$ and maturity $\tau$ quarters, and on control variables:

$$g_{t,k} = \alpha_k(\tau) + \beta_k(\tau)CS^i_t(\tau) + controls + u_{t+k}$$

The control variables are:

- Current and lagged GDP growth
- Current and lagged inflation
- 5-year term spread
- Short rate
Regress future GDP growth for horizon $k$ quarters on credit spreads for rating class $i$ and maturity $\tau$ quarters, and on control variables:

$$g_{t,k} = \alpha_{k}(\tau) + \beta_{k}(\tau)CS_{t}^{i}(\tau) + controls + u_{t+k}.$$ 

| Horizon (Obs.) | AAA 1 yr | | AAA 10 yrs | | B 1 yr | | B 10 yrs |
|----------------|----------|-------|----------|-------|----------|-------|
|                | $\beta_{k}^{AAA}$ (4) | $R^2$ | $\beta_{k}^{AAA}$ (40) | $R^2$ | $\beta_{k}^{B}$ (4) | $R^2$ | $\beta_{k}^{B}$ (40) | $R^2$ |
| 1 qrt (55)     | -2.75    | 0.21  | -2.16    | 0.26  | -0.49    | 0.27  | -0.61    | 0.26  |
| 2 qrts (55)    | -2.94    | 0.25  | -2.36    | 0.35  | -0.50    | 0.36  | -0.56    | 0.31  |
| 1 yr (55)      | -2.06    | 0.24  | -2.82    | 0.54  | -0.44    | 0.38  | -0.67    | 0.45  |
| 2 yrs (54)     | -1.74    | 0.23  | -2.81    | 0.71  | -0.29    | 0.30  | -0.48    | 0.39  |
| 3 yrs (50)     | -2.11    | 0.25  | -2.48    | 0.73  | -0.29    | 0.27  | -0.52    | 0.42  |

• The whole term structure of credit spreads across rating classes contains relevant information

• Results suggest that a number of common factors drive the forecasting power

• Regression approach does not allow to systematically analyze which spreads are most informative
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Macro-Finance Term Structure Model

Allows to disentangle the drivers of credit spreads and identify sources of predictability

- Does predictability work through channel of term premia or through expectations?
- What is the contribution of the history of the macro variables to the forecasting power?
- Which other factors that drive credit spreads are relevant for forecasting future GDP growth
- How can the (latent) finance factors be interpreted?
State Variables

Objective probability measure: $\mathbb{P}$

State vector follows Gaussian VAR(1):

$$z_t = \mu + \Phi z_{t-1} + \Sigma \epsilon_t$$

where $\epsilon_t \sim N(0, I)$

State vector - GDP growth, inflation, 3 finance factors:

$$z_t = (g_t, \pi_t, x_{1t}, x_{2t}, x_{3t})$$

Short rate:

$$r_t = \delta_0 + \delta'_z z_t$$
Yields and Spreads

Stochastic discount factor:

\[ \xi_t = -r_{t-1} - \frac{1}{2} \Lambda'_{t-1} \Lambda_{t-1} - \Lambda_{t-1} \epsilon_t \]

Essentially affine risk premia:

\[ \Lambda_t = \Lambda_0 + \Lambda z z_t \]

Treasury yields:

\[ y^T_t(\tau) \triangleq a^P(\tau) + b^P(\tau)' z_t + a^{TP}(\tau) + b^{TP}(\tau)' z_t \]

Short rate expectations + Term premium

Credit spreads:

\[ CS^i_t(\tau) \triangleq a^i,^P(\tau) + b^i,^P(\tau)' z_t + a^i,^{TP}(\tau) + b^i,^{TP}(\tau)' z_t \]

Short rate expectations + Term premium
Model estimation via ML using Kalman filter for the common sample period 1992:2-2005:4 Observation equations:

- GDP growth and inflation
- Treasury yields:
  \[ y_t^T(\tau) = a^Q(\tau) + b^Q_m(\tau)'m_t + b^Q_x(\tau)'x_t + \varepsilon_t \]
- Credit spreads:
  \[ CS_t^i(\tau) = a^{i,Q}(\tau) + b^{i,Q}_m(\tau)'m_t + b^{i,Q}_x(\tau)'x_t + \varepsilon^i_t \]
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6. Conclusion
• Do model implied spreads pick up predictability in actual spreads?
  ⇒ Yes.

• Is there predictability in estimation errors
  ⇒ Very little: only for high grade credits, long maturities and long horizons.

• Are implied spreads better predictors than actual spreads?
  ⇒ In some cases.
The Sources of Predictability

- What factors driving credit spreads are responsible for the forecasting power?
  ⇒ First, examine contribution of GDP growth and inflation

- Problem: macro variables are correlated with finance factors
  ⇒ Need to separate out influence of macro factors from everything else

- Solution: construct orthogonalized residuals using dynamic projection
\[ \text{CS}_t^i(\tau) = a_{i, \tau}^i Q(\tau) + b_{m}^{i, \tau} m_t + b_{x}^{i, \tau} (\tau)^{\prime} \hat{x}(M_t) + b_{x}^{i, \tau} (\tau)^{\prime} f_t \]
Regress future GDP growth, $g_{t,k}$, for $k$ quarters on macro component of credit spreads, $\hat{CS}_{M,t}(\tau)$:

$$g_{t,k} = \alpha_k(\tau) + \beta_{i,M}^k(\tau)CS_i^M(t(\tau)) + u_{t+k}.$$ 

<table>
<thead>
<tr>
<th>Horizon (Obs.)</th>
<th>AAA 1 yr</th>
<th>AAA 10 yrs</th>
<th>B 1 yr</th>
<th>B 10 yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\beta_{i,M}^k$ (4)</td>
<td>$R^2$</td>
<td>$\beta_{i,M}^k$ (40)</td>
<td>$R^2$</td>
</tr>
<tr>
<td>1 qrt (55)</td>
<td>-0.50</td>
<td>0.07</td>
<td>-0.50</td>
<td>0.07</td>
</tr>
<tr>
<td>2 qrts (55)</td>
<td>-0.48</td>
<td>0.11</td>
<td>-0.54</td>
<td>0.14</td>
</tr>
<tr>
<td>1 yr (55)</td>
<td>-0.42</td>
<td>0.13</td>
<td>-0.47</td>
<td>0.16</td>
</tr>
<tr>
<td>2 yrs (54)</td>
<td>-0.29</td>
<td>0.09</td>
<td>-0.38</td>
<td>0.16</td>
</tr>
<tr>
<td>3 yrs (50)</td>
<td>-0.11</td>
<td>0.02</td>
<td>-0.26</td>
<td>0.10</td>
</tr>
</tbody>
</table>

Do Credit Spreads Contain Unique Information?

- What about information contained in orthogonalized residuals?

- Is there a common “credit factor” that is important for driving credit spreads AND has forecasting power?

Exploit latent factor indeterminacy to identify the credit factor:

- First, rotate factors such that they are orthogonal to each other

- Then, fix the rotation such that the factor loading of 3-month $B$ spread is maximized
The Credit Factor and Credit Spreads

Correlation of $f_1$ with selected credit spreads

<table>
<thead>
<tr>
<th></th>
<th>3 months</th>
<th>2 years</th>
<th>7 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>$B$</td>
<td>81%</td>
<td>74%</td>
<td>58%</td>
</tr>
<tr>
<td>$BBB$</td>
<td>70%</td>
<td>69%</td>
<td>48%</td>
</tr>
<tr>
<td>$AAA$</td>
<td>14%</td>
<td>45%</td>
<td>25%</td>
</tr>
</tbody>
</table>

$f_1$ vs. B credit spreads

- Green: B 3m
- Blue: B 10yrs
- Red dashed: $f_1$
Normalized Factor Loadings: Credit Factor

The graph illustrates the normalized factor loadings for different types of credit, including Treasuries, AAA, BBB, and B ratings. The x-axis represents the factor loading scale, ranging from -1 to 1, while the y-axis shows the percentage of factor loadings for each credit rating category. The lines for each rating type are color-coded to distinguish their relationships with the factor loading.
Index of Tighter Loan Standards

Correlations of the Index of Tighter Loan Standard with finance factors

<table>
<thead>
<tr>
<th>$f_1$</th>
<th>$f_2$</th>
<th>$f_3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>51%</td>
<td>-5%</td>
<td>-22%</td>
</tr>
</tbody>
</table>

$f_1$ vs. index of tighter loan standards

- $f_1$: Loan standards
- $f_1$:
The Level Factor

Correlations of $f_2$ with selected interest rates

<table>
<thead>
<tr>
<th></th>
<th>3 months</th>
<th>2 years</th>
<th>7 years</th>
<th>Fed funds target</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>75%</td>
<td>73%</td>
<td>55%</td>
<td>73%</td>
</tr>
</tbody>
</table>

$f_2$ vs. Federal funds target rate

Fed funds target

$f_2$
Normalized Factor Loadings: Level and Slope Factors

Level factor
- Treasuries
- AAA
- BBB
- B

Slope factor
- Treasuries
- AAA
- BBB
- B
## Finance Factors, Yields and Credit Spreads

<table>
<thead>
<tr>
<th></th>
<th>credit ($f_1$)</th>
<th>level ($f_2$)</th>
<th>slope ($f_3$)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Treasury yields</strong></td>
<td>short</td>
<td>–</td>
<td>++</td>
</tr>
<tr>
<td></td>
<td>long</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td><strong>AAA spreads</strong></td>
<td>short</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td></td>
<td>long</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><strong>BBB spreads</strong></td>
<td>short</td>
<td>+ + +</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>long</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><strong>B spreads</strong></td>
<td>short</td>
<td>+ + +</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>long</td>
<td>++</td>
<td>0</td>
</tr>
</tbody>
</table>
Forecasting Power of the Finance Factors

Regress future GDP growth on the orthogonalized residuals

\[ g_{t,k} = \alpha_k + \beta^f_{k} f_{j,t} + u_{t+k}, \]

for \( j = \{1, 2, 3\} \) and \( f_j \) denotes the credit, level and slope factors, respectively.

<table>
<thead>
<tr>
<th>Horizon (Obs.)</th>
<th>credit ((f_1))</th>
<th>level ((f_2))</th>
<th>slope ((f_3))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(\beta^f_{k})</td>
<td>(R^2)</td>
<td>(\beta^f_{k})</td>
</tr>
<tr>
<td>1 qrt (55)</td>
<td>-0.50 0.07</td>
<td>0.37 0.04</td>
<td>0.36 0.04</td>
</tr>
<tr>
<td>2 qrts (55)</td>
<td>-0.52 0.13</td>
<td>0.22 0.02</td>
<td>0.27 0.04</td>
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<td>1 yr (55)</td>
<td>-0.54 0.21</td>
<td>0.07 0.00</td>
<td>0.23 0.04</td>
</tr>
<tr>
<td>2 yrs (54)</td>
<td>-0.48 0.26</td>
<td>0.15 0.03</td>
<td>0.20 0.05</td>
</tr>
<tr>
<td>3 yrs (55)</td>
<td>-0.64 0.54</td>
<td>0.25 0.10</td>
<td>0.26 0.11</td>
</tr>
</tbody>
</table>

Credit factor and macro factors capture virtually all predictive power (higher $R^2$s than actual credit spreads)

- Macro factors relevant for short maturities and horizons
- credit factor ($f_1$) strong contributor for longer horizons
- In multivariate regressions, level and slope factors ($f_2$ and $f_3$) still insignificant
Relative Contribution of Credit Factor

![Graph showing the relative contribution of credit factor over time for different credit ratings.]
Replace observable macro factors GDP growth and inflation by:

- Real time data
- Principal components of large macro data set

Correlation of original data with factors using alternative macro data:

<table>
<thead>
<tr>
<th></th>
<th>GDP</th>
<th>inflation</th>
<th>credit</th>
<th>level</th>
<th>slope</th>
</tr>
</thead>
<tbody>
<tr>
<td>real time data</td>
<td>67%</td>
<td>100%</td>
<td>93%</td>
<td>79%</td>
<td>95%</td>
</tr>
<tr>
<td>principal components</td>
<td>-57%</td>
<td>13%</td>
<td>79%</td>
<td>60%</td>
<td>48%</td>
</tr>
</tbody>
</table>
The Credit Factor 2005-2008

Normalized $B$ 1-year spreads and components

Credit
Leve
Slo
Macro
B 1yr

Credit
Level
Slope
Macro
B 1yr


-3
-2
-1
0
1
2
3
Credit
Level
Slope
Macro
B 1yr

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Conclusion

- Provide a framework that allows disentangling drivers of credit spreads and gives useful interpretation.

- Decompose credit spreads into separate components and link them back to future GDP growth.

- Identify a credit factor that is independent of the macro variables and is useful in predicting future real activity over and above information contained in the observable macro variables.
Conclusion (cont.)

- Observable macro variables and the credit factor capture virtually all predictive power inherent in credit spreads
  
  - Current and lagged inflation and GDP growth are especially important for short horizon forecasts and longer maturity spreads
  
  - Credit factor is relevant for all spreads at all forecast horizons
Conclusion (cont.)

• The credit factor is highly correlated with the index of tighter loan standards and can be interpreted as a proxy for credit conditions.

• The results are consistent with the existence of a transmission channel from borrowing conditions to real activity.

• I plan to further investigate the link between credit conditions and the real economy in a more structural model.