# Credit Spreads and Real Activity

Philippe Mueller

Columbia Business School

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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.”

# Research Questions

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?

# Credit Spreads and Real Activity

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

# Outline

# Data

- 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)

# 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:

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

The control variables are

- Current and lagged GDP growth
- Current and lagged inflation
- 5-year term spread
- Short rate

# Credit Spread Regressions

## Coefficient Estimates

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

$$g_{t,k} = \alpha_k(\tau) + \beta_k(\tau) CS_t^i(\tau) + controls + u_{t+k}.$$

| | **AAA 1 yr** | | **AAA 10 yrs** | | **B 1 yr** | | **B 10 yrs** | |
|---|---|---|---|---|---|---|---|---|
| Horizon (Obs.) | $\beta_k^{AAA}(4)$ | $R^2$ / $\bar{R}^2$ | $\beta_k^{AAA}(40)$ | $R^2$ / $\bar{R}^2$ | $\beta_k^{B}(4)$ | $R^2$ / $\bar{R}^2$ | $\beta_k^{B}(40)$ | $R^2$ / $\bar{R}^2$ |
| 1 qrt | -2.75 | 0.21 | -2.16 | 0.26 | -0.49 | 0.27 | -0.61 | 0.26 |
| (55) | (1.90) | 0.09 | (1.09) | 0.15 | (0.16)* | 0.16 | (0.22)* | 0.15 |
| 2 qrts | -2.94 | 0.25 | -2.36 | 0.35 | -0.50 | 0.36 | -0.56 | 0.31 |
| (55) | (1.64) | 0.14 | (1.01)* | 0.25 | (0.14)* | 0.26 | (0.20)* | 0.21 |
| 1 yr | -2.06 | 0.24 | -2.82 | 0.54 | -0.44 | 0.38 | -0.67 | 0.45 |
| (55) | (1.30) | 0.13 | (0.80)* | 0.47 | (0.13)* | 0.29 | (0.17)* | 0.37 |
| 2 yrs | -1.74 | 0.23 | -2.81 | 0.71 | -0.29 | 0.30 | -0.48 | 0.39 |
| (54) | (0.88) | 0.11 | (0.62)* | 0.67 | (0.12)* | 0.20 | (0.15)* | 0.30 |
| 3 yrs | -2.11 | 0.25 | -2.48 | 0.73 | -0.29 | 0.27 | -0.52 | 0.42 |
| (50) | (0.68)* | 0.13 | (0.55)* | 0.69 | (0.13)* | 0.15 | (0.16)* | 0.32 |

Hodrick (1992) 1B standard errors in parentheses. * denotes significantly different from zero at 5% level. Sample period: 1992:Q2–2005:Q4, GDP data is included up to 2007:Q3.

# Regression Results: Summary

- 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

# 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:

$$y_t^T(\tau) \triangleq \underbrace{a^{\mathbb{P}}(\tau) + b^{\mathbb{P}}(\tau)' z_t}_{\text{Short rate expectations}} + \underbrace{a^{TP}(\tau) + b^{TP}(\tau)' z_t}_{\text{Term premium}}$$

Credit spreads:

$$CS_t^i(\tau) \triangleq \underbrace{a^{i,\mathbb{P}}(\tau) + b^{i,\mathbb{P}}(\tau)' z_t}_{\text{Short rate expectations}} + \underbrace{a^{i,TP}(\tau) + b^{i,TP}(\tau)' z_t}_{\text{Term premium}}$$

# Model Estimation

Model estimation via ML using Kalman filter for the common sample period 1992:2-2005:4 Observation equations:

- GDP growth and inflation
- Treasury yields:

$$y_t^T(\tau) = a^{\mathbb{Q}}(\tau) + b_m^{\mathbb{Q}}(\tau)' m_t + b_x^{\mathbb{Q}}(\tau)' x_t + \varepsilon_t$$

- Credit spreads:

$$CS_t^i(\tau) = a^{i,\mathbb{Q}}(\tau) + b_m^{i,\mathbb{Q}}(\tau)' m_t + b_x^{i,\mathbb{Q}}(\tau)' x_t + \varepsilon_t^i$$

# Forecasting Power of Implied Credit Spreads

- Do model implied spreads pick up predictability in actual spreads?

  $\Rightarrow$ Yes.

- Is there predictability in estimation errors

  $\Rightarrow$ Very little: only for high grade credits, long maturities and long horizons.

- Are implied spreads better predictors than actual spreads?

  $\Rightarrow$ In some cases.

# The Sources of Predictability

- What factors driving credit spreads are responsible for the forecasting power?

  $\Rightarrow$ First, examine contribution of GDP growth and inflation

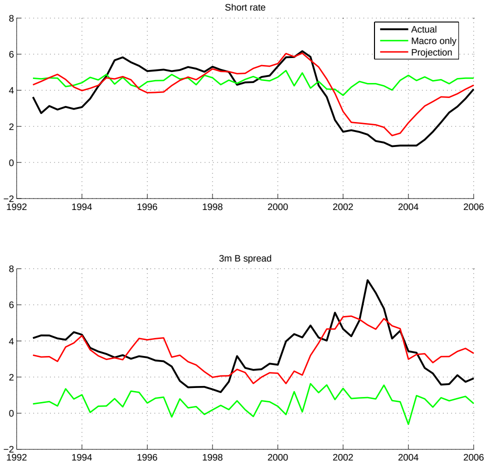
- Problem: macro variables are correlated with finance factors

  $\Rightarrow$ Need to separate out influence of macro factors from everything else

- Solution: construct orthogonalized residuals using dynamic projection

# Projection

$$CS_t^i(\tau) \quad = \quad a^{i,\mathbb{Q}}(\tau) + b_m^{i,\mathbb{Q}}(\tau)' m_t + b_x^{i,\mathbb{Q}}(\tau)' \widehat{x}(M_t) + b_x^{i,\mathbb{Q}}(\tau)' f_t$$



# The Projection Component

## Coefficient Estimates

Regress future GDP growth, $g_{t,k}$, for $k$ quarters on macro component of credit spreads, $\widehat{CS}^{i}_{M,t}(\tau)$:

$$g_{t,k} = \alpha_k(\tau) + \beta_k^{i,M}(\tau) CS^{i}_{M,t}(\tau) + u_{t+k}.$$

| | ***AAA* 1 yr** | | ***AAA* 10 yrs** | | ***B* 1 yr** | | ***B* 10 yrs** | |
|---|---|---|---|---|---|---|---|---|
| Horizon (Obs.) | $\beta_k^{i,M}(4)$ | $R^2$ $\bar{R}^2$ | $\beta_k^{i,M}(40)$ | $R^2$ $\bar{R}^2$ | $\beta_k^{i,M}(4)$ | $R^2$ $\bar{R}^2$ | $\beta_k^{i,M}(40)$ | $R^2$ $\bar{R}^2$ |
| 1 qrt | -0.50 | 0.07 | -0.50 | 0.07 | -0.48 | 0.06 | -0.56 | 0.09 |
| (55) | (0.26) | 0.05 | (0.24)* | 0.05 | (0.26) | 0.05 | (0.21)* | 0.07 |
| 2 qrts | -0.48 | 0.11 | -0.54 | 0.14 | -0.45 | 0.10 | -0.58 | 0.17 |
| (55) | (0.24)* | 0.10 | (0.23)* | 0.13 | (0.25) | 0.08 | (0.20)* | 0.15 |
| 1 yr | -0.42 | 0.13 | -0.47 | 0.16 | -0.29 | 0.06 | -0.45 | 0.15 |
| (55) | (0.20)* | 0.11 | (0.19)* | 0.15 | (0.25) | 0.04 | (0.17)* | 0.14 |
| 2 yrs | -0.29 | 0.09 | -0.38 | 0.16 | -0.07 | 0.01 | -0.29 | 0.10 |
| (54) | (0.15) | 0.08 | (0.16)* | 0.15 | (0.24) | 0.01 | (0.15) | 0.08 |
| 3 yrs | -0.11 | 0.02 | -0.26 | 0.10 | 0.12 | 0.02 | -0.12 | 0.02 |
| (50) | (0.13) | 0.00 | (0.14) | 0.08 | (0.22) | 0.00 | (0.15) | 0.00 |

Hodrick (1992) 1B standard errors in parentheses. * denotes significantly different from zero at 5% level. Sample period: 1992:Q2–2005:Q4, GDP data is included up to 2007:Q3.

# 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?

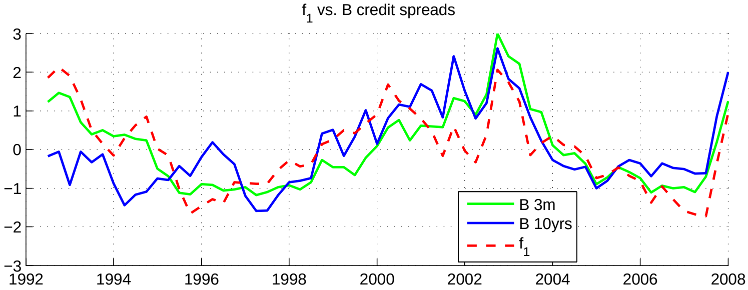
Exploit latent factor indeterminacy to identify the credit factor:

- 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

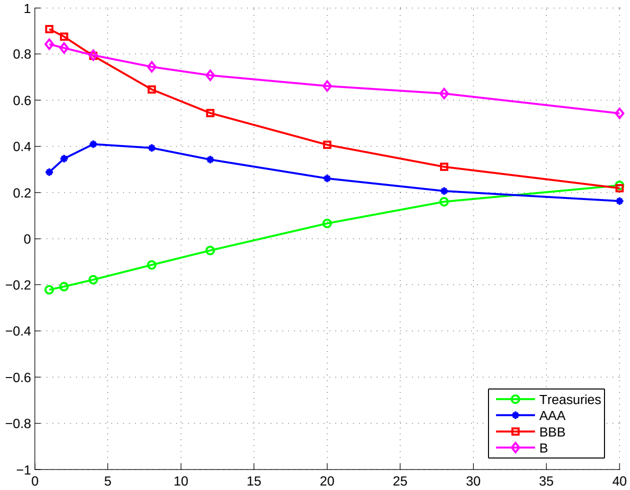
# The Credit Factor and Credit Spreads

## Correlation of $f_1$ with selected credit spreads

| | 3 months | 2 years | 7 years |
|---|---|---|---|
| *B* | 81% | 74% | 58% |
| *BBB* | 70% | 69% | 48% |
| *AAA* | 14% | 45% | 25% |



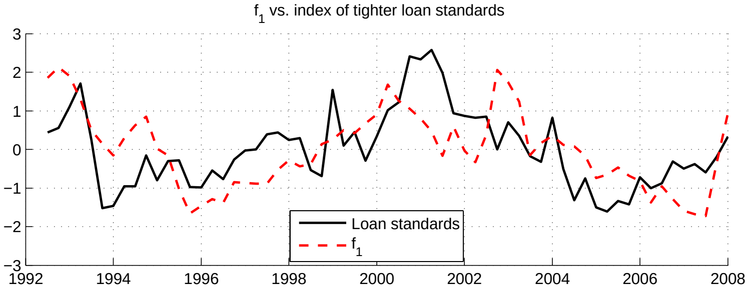
# Normalized Factor Loadings: Credit Factor



# Index of Tighter Loan Standards

Correlations of the Index of Tighter Loan Standard with finance factors

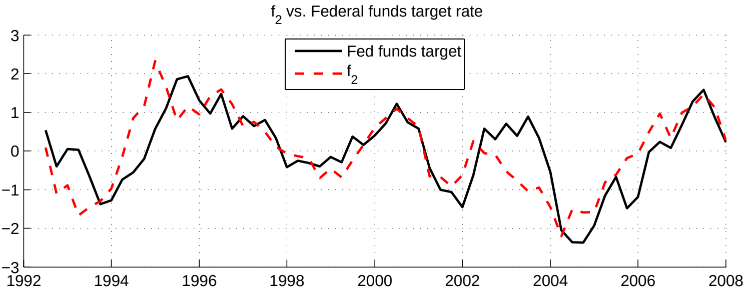
| $f_1$ | $f_2$ | $f_3$ |
|---|---|---|
| 51% | -5% | -22% |



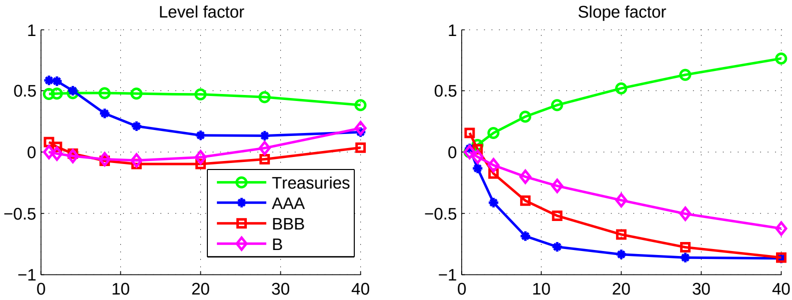
# The Level Factor

## Correlations of $f_2$ with selected interest rates

| 3 months | 2 years | 7 years | Fed funds target |
|---|---|---|---|
| 75% | 73% | 55% | 73% |



# Normalized Factor Loadings: Level and Slope Factors



# Finance Factors, Yields and Credit Spreads

| | | credit ($f_1$) | level ($f_2$) | slope ($f_3$) |
|---|---|---|---|---|
| **Treasury yields** | short | $-$ | $++$ | 0 |
| | long | $+$ | $++$ | $++$ |
| ***AAA* spreads** | short | $++$ | $++$ | 0 |
| | long | $+$ | $+$ | $--$ |
| ***BBB* spreads** | short | $+++$ | 0 | 0 |
| | long | $+$ | $+$ | $--$ |
| ***B* spreads** | short | $+++$ | 0 | 0 |
| | long | $++$ | 0 | $--$ |

# Forecasting Power of the Finance Factors

Regress future GDP growth on the orthogonalized residuals

$$g_{t,k} = \alpha_k + \beta_k^{f_j} f_{j,t} + u_{t+k},$$

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

| | credit ($f_1$) | | level ($f_2$) | | slope ($f_3$) | |
|---|---|---|---|---|---|---|
| Horizon (Obs.) | $\beta_k^{f_1}$ | $R^2$ $\bar{R}^2$ | $\beta_k^{f_2}$ | $R^2$ $\bar{R}^2$ | $\beta_k^{f_3}$ | $R^2$ $\bar{R}^2$ |
| 1 qrt | -0.50 | 0.07 | 0.37 | 0.04 | 0.36 | 0.04 |
| (55) | (0.25)* | 0.05 | (0.23) | 0.02 | (0.24) | 0.02 |
| 2 qrts | -0.52 | 0.13 | 0.22 | 0.02 | 0.27 | 0.04 |
| (55) | (0.25)* | 0.12 | (0.23) | 0.00 | (0.23) | 0.02 |
| 1 yr | -0.54 | 0.21 | 0.07 | 0.00 | 0.23 | 0.04 |
| (55) | (0.21)* | 0.20 | (0.20) | 0.01 | (0.21) | 0.02 |
| 2 yrs | -0.48 | 0.26 | 0.15 | 0.03 | 0.20 | 0.05 |
| (54) | (0.18)* | 0.24 | (0.15) | 0.01 | (0.16) | 0.03 |
| 3 yrs | -0.64 | 0.54 | 0.25 | 0.10 | 0.26 | 0.11 |
| (55) | (0.18)* | 0.53 | (0.13) | 0.08 | (0.16) | 0.09 |

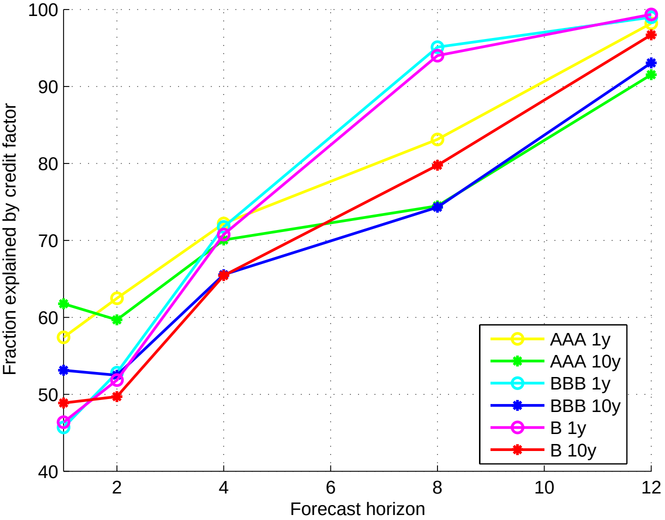
Hodrick (1992) 1B standard errors in parentheses. * denotes significantly different from zero at 5% level. Sample period: 1992:Q2–2005:Q4, GDP data is included up to 2007:Q3.

# Relative Contributions of Factors

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



# Alternative Macro Factors

Replace observable macro factors GDP growth and inflation by:

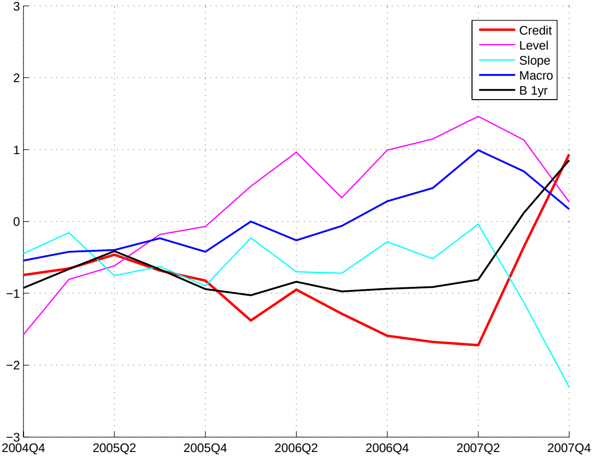
- Real time data
- Principal components of large macro data set

Correlation of original data with factors using alternative macro data:

| | GDP | inflation | credit | level | slope |
|---|---|---|---|---|---|
| real time data | 67% | 100% | 93% | 79% | 95% |
| principal components | -57% | 13% | 79% | 60% | 48% |

# The Credit Factor 2005-2008

## Normalized *B* 1-year spreads and components



# 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