# Modeling Retail Interest Rates in the Czech Economy

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# Outline of the presentation

Presentation:

- Motivation
- Stylized facts
- Econometric model
- Conclusion

**What is it all about?**

**Retail credit premium** is defined as the difference between reference interest rates and rates on retail loans with *comparable maturities*.

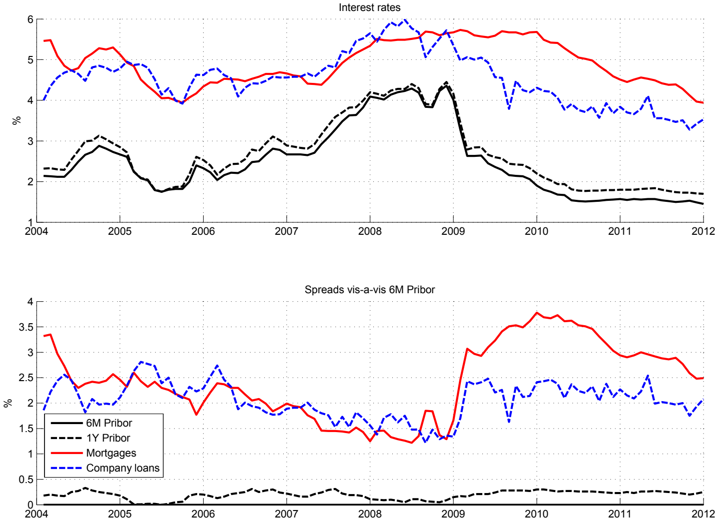
# Motivation

Money market interest rates started to fall at the start of 2009, while retail rates on loans were either flat or falling more slowly than money market rates.

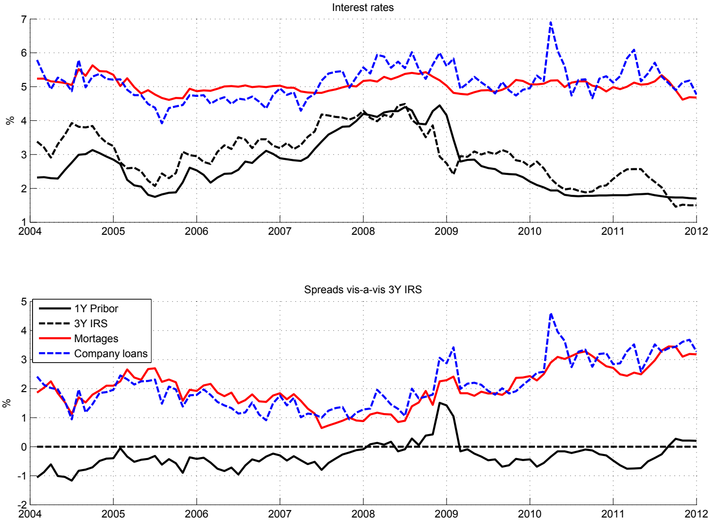
Why this is important?

1. The credit premium is an important part of the monetary policy transmission mechanism: monetary policy rate $\Rightarrow$ money market rates $\Rightarrow$ retail rates.
   - As the credit premium have been growing during the crisis, questions are being asked about how well the second link in the transmission mechanism works.
2. Do financial variables have predictive power for macroeconomic aggregates?
   - If they do, the toolkit used in central banks for short-term forecasting can be expanded.
   - The second moments observed in data can also be used to discriminate among alternative macroeconomic framework on macro-finance linkages.
3. Can macroeconomic variables contribute to the forecasting of selected aggregate financial variables?
   - If so, there is a clear significance for financial stability, as it may facilitate more accurate construction of stress tests scenarios.
   - In this research, I ask about the predicability of non-performing loans.

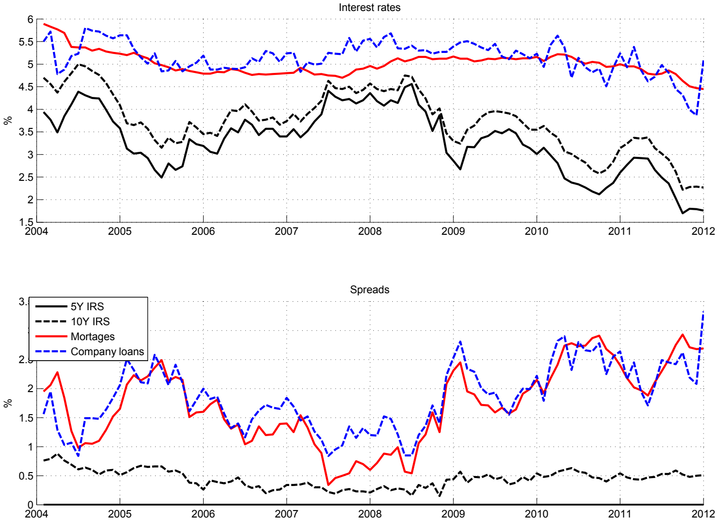
# Stylized facts – interest rates with maturity less than 1 year



# Stylized facts – interest rates with maturity 1–5 years



# Stylized facts – interest rates with maturity > 5 years



# Dynamic correlation between selected variables

As a first look at the dynamic relation between macro and financial variables, dynamic correlations have been computed:

- unconditional;
- specific to business cycle:
  - this may be important as a permanent trend in one variable can obscure a cyclical correlations with variable of interest.

# Dynamic correlation between selected variables – estimation

How BC correlations are estimated:

- First, I estimate the joint (multivariate) spectral density of data $\mathbf{s}_X(\omega)$ for $\omega \in [0, 2\pi)$, defined as

$$\mathbf{s}_X(\omega) = \frac{1}{2\pi} \sum_{k=-\infty}^{\infty} \Gamma_k e^{-i\omega k},$$

with $\Gamma_k = \mathbf{E}\left[(x_t - \mu)(x_{t-k} - \mu)^T\right]$ is the dynamic covariance matrix.

  - It is well known that the integral of the spectral density is equal to the unconditional second moments:

$$\int_0^{2\pi} \mathbf{s}_X e^{i\omega k}(\omega)\,\mathrm{d}\omega = \Gamma_k,$$

- If you integrate the integral over the specific frequency band, you obtain the second moments specific to those frequencies:
  - the business cycle is usually defined as frequencies between 6 and 32 quarters, hence $\int_{\frac{2\pi}{128}}^{\frac{2\pi}{18}} \mathbf{s}_X(\omega) e^{i\omega k}\,\mathrm{d}\omega$ gives you the covariance at lag $k$ specific to these frequencies (given monthly data)
- you can think about the frequency-specific correlations as of correlations which would be obtained if a band-pass filter were applied to data.

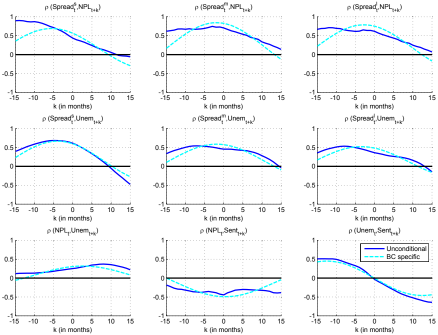
# Dynamic correlation between selected variables – estimation

The multivariate spectral density has been estimated using the Bartlett non-parametric approach:

$$\hat{\mathbf{s}}_X(\omega) = \frac{1}{2\pi}\left\{\hat{\Gamma}_0 + \sum_{k=1}^{q}\left[1 - \frac{k}{q+1}\right]\left[\hat{\Gamma}_k e^{-i\omega k} + \hat{\Gamma}_{-k} e^{+i\omega k}\right]\right\},$$

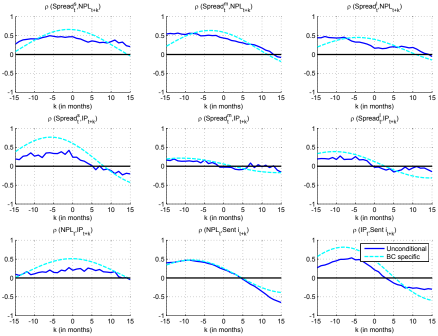
where $\hat{\Gamma}_k$ are sample counterparts of population covariance matrices $\Gamma_k$.

# Dynamic correlations of retail spreads with macro and financial variables – mortgages




- the increase in the retail spreads leads the NPL and unemployment by about 3 to 6 months;
  - forward-lookiness of financial institutions?
- NPL and households' sentiment co-moves,
- unemployment is not a good leading (or lagging) indicator of NPLs.

# Dynamic correlations of retail spreads with macro and financial variables – company loans




- again, the increase in the retail spreads leads the NPL and industrial production by about 3 to 6 months;
- IP leads the economic sentiments,
  - hence it seems that the sentiment indicator is a lagging indicator rather than leading,
- NPL does not seem to predict any real variable.

# Dynamic factor model

Given the estimates of the multivariate spectral density, one can easily estimates a **dynamic factor model**.

Frequency domain: DFM can be used to assess the comovements in data at various frequencies:

- it is quite possible that two time series have similar cycles at one frequency, but are unrelated at the other frequencies,
- standard factor models cannot be easily used to model such a relation.

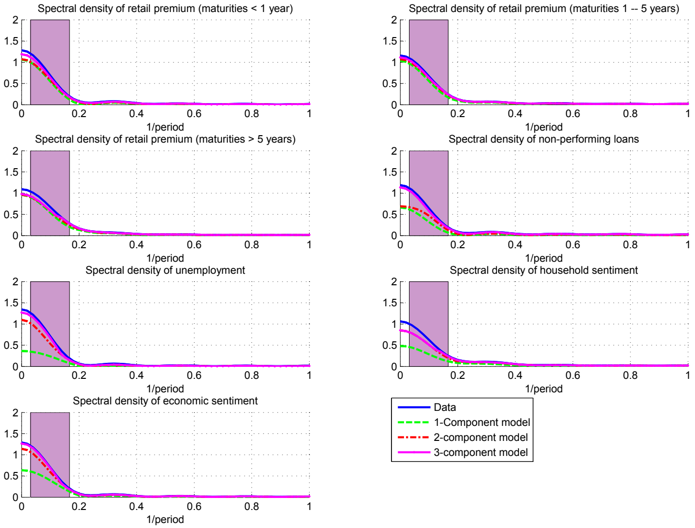
Time domain: unlike the static factor models, co-movements across various leads or lags are easily taken into the account.

One-sided representation:

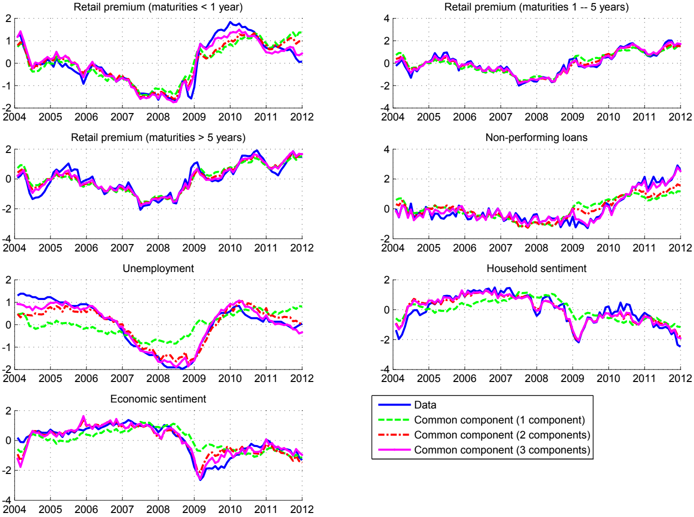
$$x_t = \Lambda_0 f_t + \Lambda_1 f_{t-1} + \ldots + \Lambda_h f_{t-h} + \varepsilon_t,$$

where the dimension of $f_t$ should be smaller than that of data $x_t$.

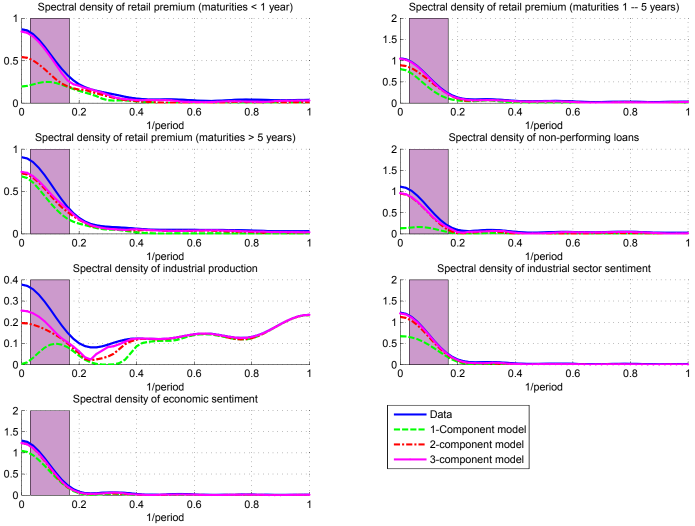
# DFM and spectral densities – mortgages



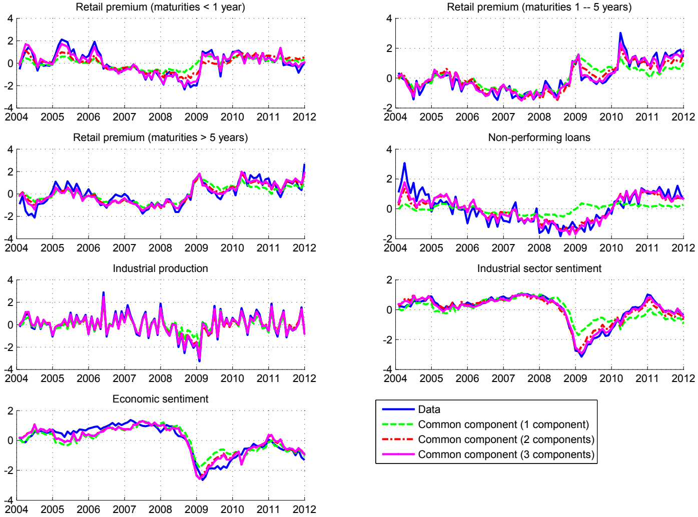
# DFM and one-sided representation of data – mortgages



# DFM and spectral densities – corporate loans



# DFM and one-sided representation of data – corporate loans



# NPL and credit premium

It seems that data suggests that NPL are less sensitive to the cycle than the evolution of the retail credit premium would suggests.

If a risk-free rate $i_t^k$ of maturity $k$ is given as:

$$i_t^k = -k^{-1} \log \mathbf{E}_t \left[ exp(m_t^{t+k}) \right],$$

where $m_t^{t+k}$ is the pricing kernel, the retail interest rate is given as:

$$y_t^k = -k^{-1} \log \mathbf{E}_t \left[ exp(m_t^{t+k})/exp(\pi_t) \right],$$

where $\pi$ is the objective risk of the contract, then the retail premium is given as:

$$y_t^k - i_t^k = k^{-1} \left[ \left( \mathbf{E}_t \pi_t + \frac{1}{2} \mathbf{V}_t \pi_t \right) + cov(\pi_t, m_t^{t+k}) \right].$$

If the covariance term $cov(\pi_t, m_t^{t+k})$ is not constant:

- it is expected that the elasticity of retail credit premia to risk would be greater (lower) if $cov(\pi_t, m_t^{t+k})$ is positive (negative);
- affine models of interest rates would have problem in dealing with this feature (as second moments are constant by construction).

# Decomposition of credit premia

I filter out the part of the credit premium, which is not explained by the objective risk and here are the results:

SIMULATION RESULTS

| Type of loan | Rate fixation | Reference rate | Equilibrium premium (in p.p.) | Credit premium volatility (standard deviation) | Percentage of volatility explained by macro risk |
|---|---|---|---|---|---|
| Loans to households for house purchase | < 1 year | 6M Pribor | 2.36 | 0.86 | 88.1 |
| | 1–5 years | 3Y IRS | 1.80 | 0.74 | 76.0 |
| | 5–10 years | 7Y IRS | 1.11 | 0.46 | 49.9 |
| Corporate loans up to CZK 30 million | < 1 year | 6M Pribor | 2.05 | 0.38 | 57.9 |
| | 1–5 years | 3Y IRS | 1.88 | 0.70 | 43.6 |
| | 5+ years | 7Y IRS | 1.55 | 0.50 | 30.2 |
| Corporate loans over CZK 30 million | < 1 year | 6M Pribor | 0.87 | 0.29 | 13.6 |
| | 1–5 years | 3Y IRS | 0.33 | 0.54 | 51.7 |
| | 5+ years | 7Y IRS | 0.40 | 0.76 | 45.7 |

# Conclusion

This article presented a retail credit premium model that explains this premium on the basis of macroeconomic risk:

- results reveal that the premium is strongly correlated with the macroeconomic risks;
- the premium can be also a leading indicator of other variables, such as NPL, unemployment, or industrial production.

# Closing slide

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The previous (and less technical) version of this research has appeared in the Financial Stability Report 2010–2011.

An updated and more technical version is under construction ....
... so comments are welcome.