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United States Department of Agriculture

Latent Risk Estimation in Commercial Bank Delinquency Rates

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SCC-76 Meetings

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Outline

- Motivation
- Methodology
- Data/Estimation Procedure
- Results
- Discussion

Motivation

- Increased potential for farm loan repayment issues
- Prior work concentrates on risk in an expected loss framework for a given bank portfolio (Featherstone, Roessler and Barry, 2008; Katchova and Barry, 2005; Phillips and Katchova, 2004)
- We examine the dynamics of systemic delinquency risk across the agricultural sector
- Focus on real estate and non-real estate loans by commercial lenders

Latent Risk State Space Model

- Model based on Durbin and Koopman, 2001
- Application to Dutch traffic fatalities Bijleveld, Commandeur, Gould, and Koopman, 2008
- Latent factors, or unobserved components, for exposure (loan volume) and risk (delinquency volume) are estimated in a state space procedure as follows:
 - $LV_{it} = E_{it} * U_{it}^{LV}$ (Exposure)
 - $DV_{it} = E_{it} * R_{it} * U_{it}^{DV}$ (Delinquency)

Latent Risk Model

- Variable in logs
- Estimations include seasonal dummy variables in observation equations
- Model:
 - Observation equations:
 - $LV_t = u_t^1 + \gamma_{d(1,3)} + \varepsilon_t^1$
 - $DV_t = u_t^1 + u_t^2 + \gamma_{d(1,3)} + \varepsilon_t^2$
 - State Equations:
 - $u_t^1 = u_{t-1}^1 + v_{t-1}^1 + \varepsilon_t^1$ (Loan volume trend)
 - $v_t^1 = v_{t-1}^1 + \tau_t^1$ (Loan volume slope)
 - $u_t^2 = u_{t-1}^2 + v_{t-1}^2 + \varepsilon_t^2$ (Delinquency volume trend)
 - $v_t^2 = v_{t-1}^2 + \tau_t^2$ (Delinquency volume slope)

Data

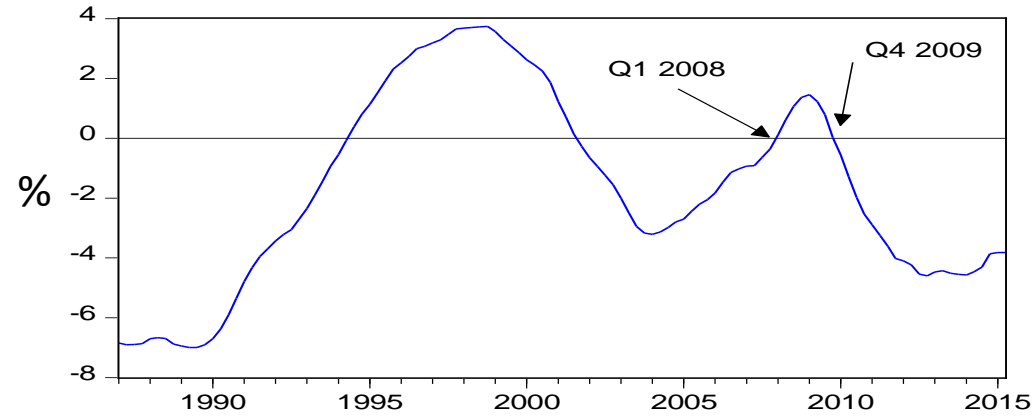
- Agricultural Finance Databook (B tables)
 - Total Loan Volume (B.1)
 - Real Estate - Quarterly, 1991 Q1 – 2015 Q2
 - Non-Real Estate - Quarterly, 1987 Q1 – 2015 Q2
 - Total Delinquent Loan Volume
 - Real Estate (B.4) - Quarterly, 1991 Q1 – 2015 Q2
 - Non-Real Estate (B.2) - Quarterly, 1987 Q1 – 2015 Q2

Estimation Procedure

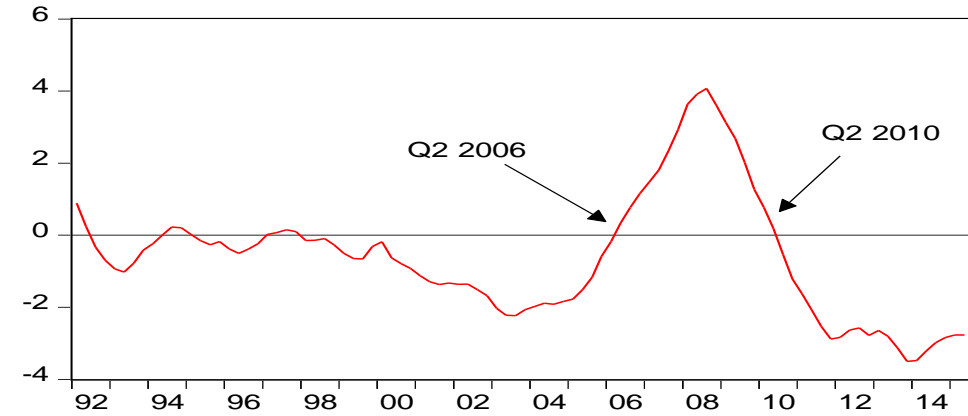
- Maximum Likelihood using BFGS non-linear optimization algorithm
 - Tried Newton-Raphson and BHHH as well. Results similar.
- Solving for 9 variables plus seasonality coefficients
- Starting values randomly drawn 1000 times
 - Converged 52 times for non-real estate model
 - Converged 142 times for real estate model
 - Non Real Estate: LLV = 111.9, AIC = -1.7; Real Estate: LLV = 362.71, AIC = -7.09
- Focus of this research is on the slope state space variables. Variables converted to percent by $100 * (\exp(SV) - 1)$
 - Smoothed state estimates

Delinquency Risk (delinquency volume slope state variable)

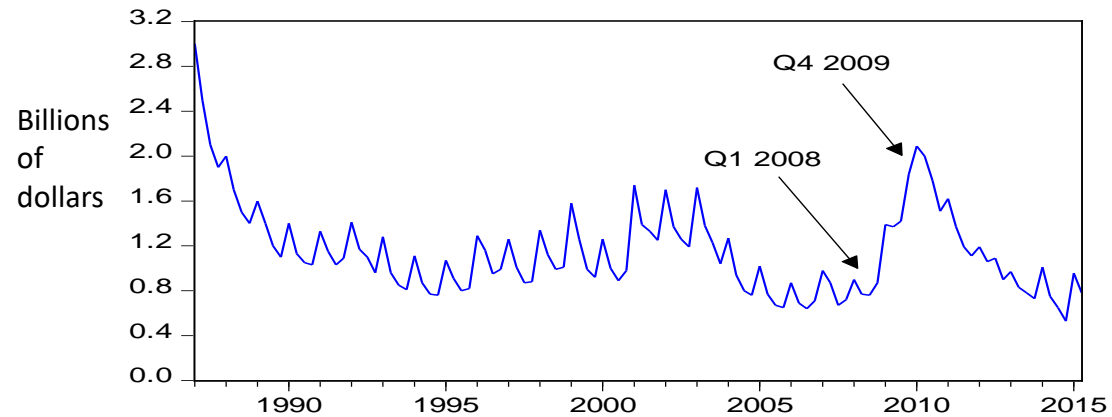
Non-Real Estate Delinquency Risk



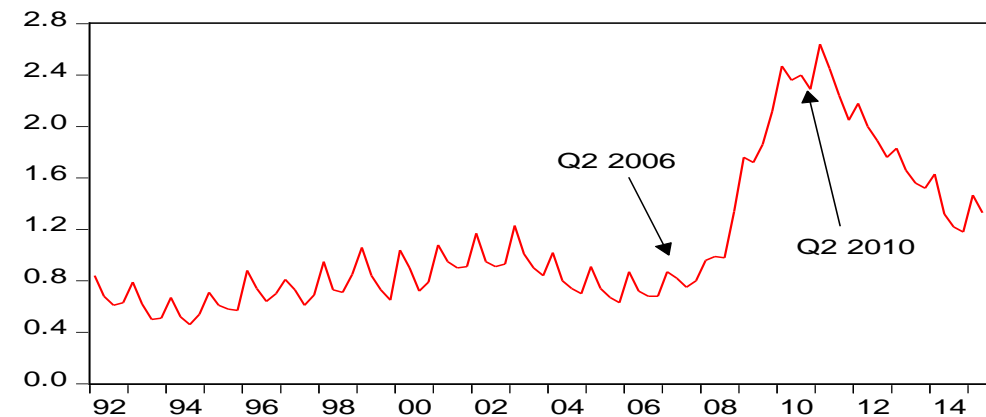
Real Estate Delinquency Risk



Non-Real Estate Loan Delinquency Volume

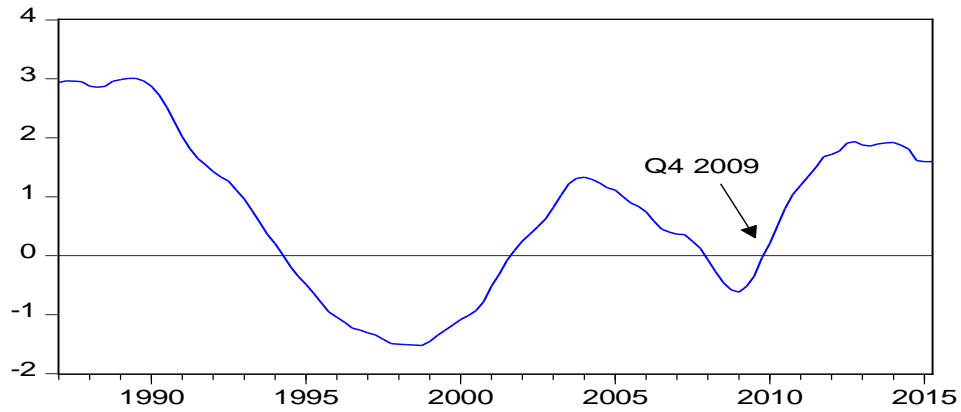


Real Estate Loan Delinquency Volume

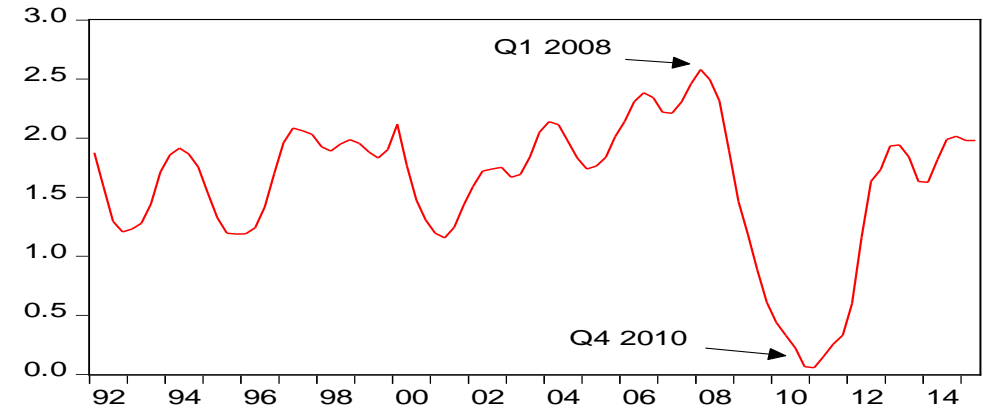


Exposure Rate (loan volume slope state variable)

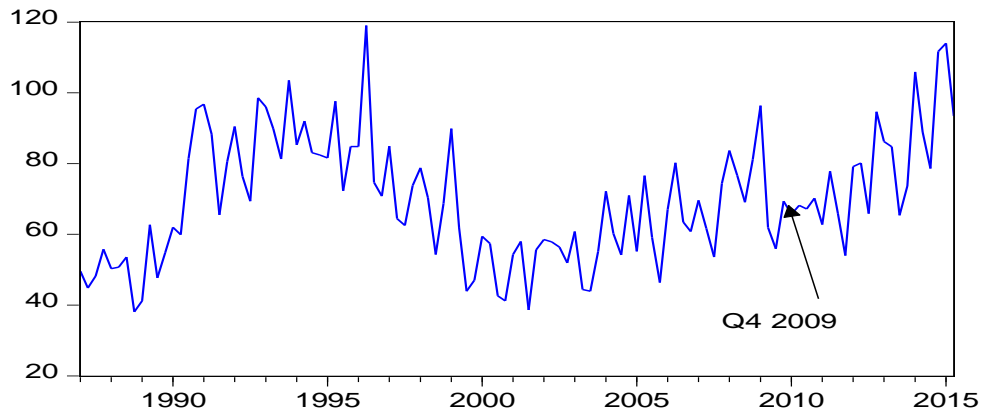
Quarterly Exposure Growth - Non Real Estate Loans



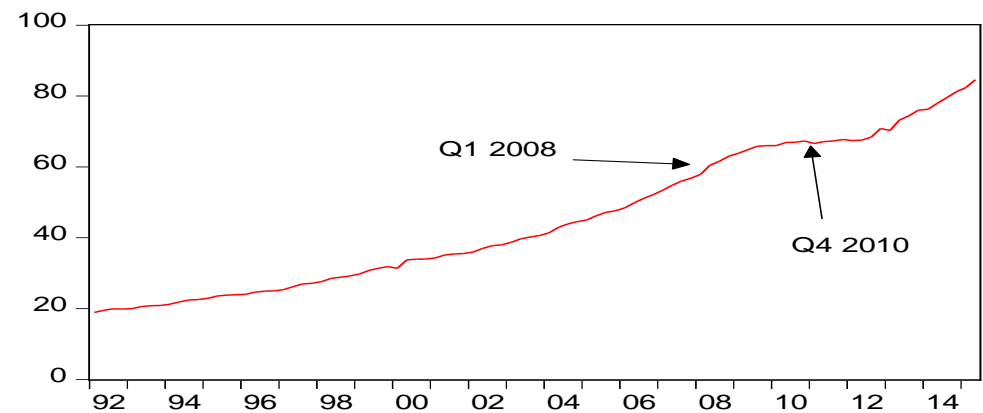
Quarterly Exposure Growth - Real Estate Loans



Volume of Non Real Estate Loans



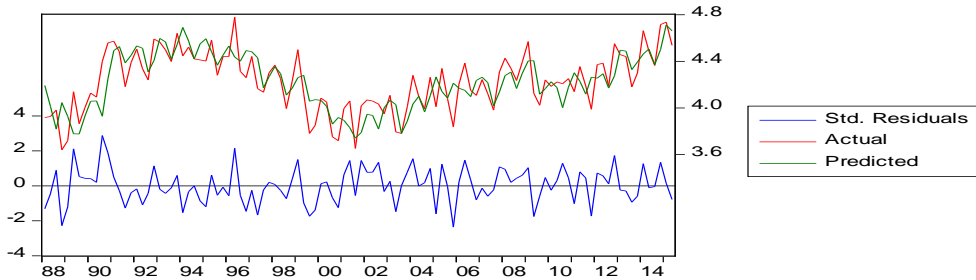
Volume of Real Estate Loans



Residual Diagnostics

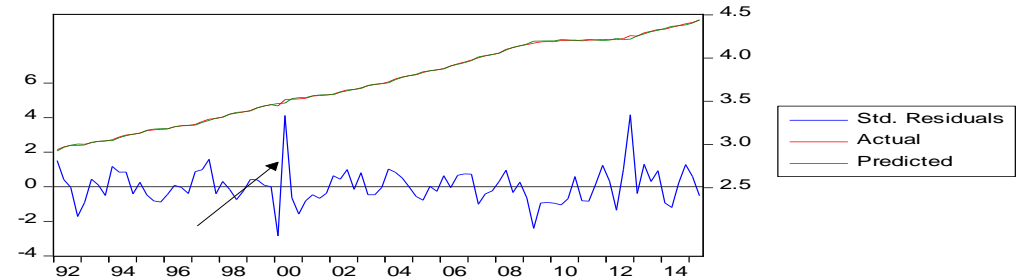
- Residuals are normal and independent for non-re estimation

One-step-ahead Non-Real Estate Loan Volume Predictions

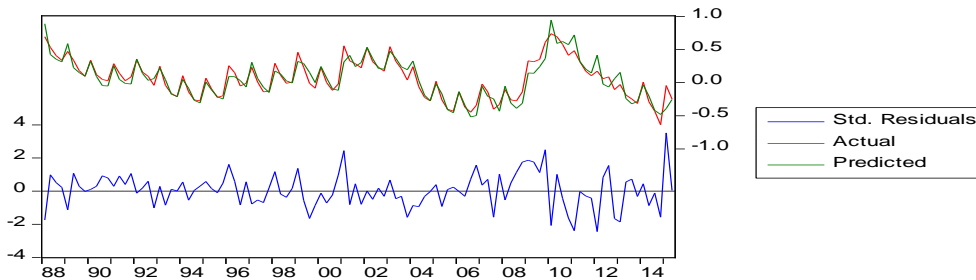


- Real estate loan volume residuals slight positive autocorrelation. Unsure why an issue in Q1/Q2 of 2001

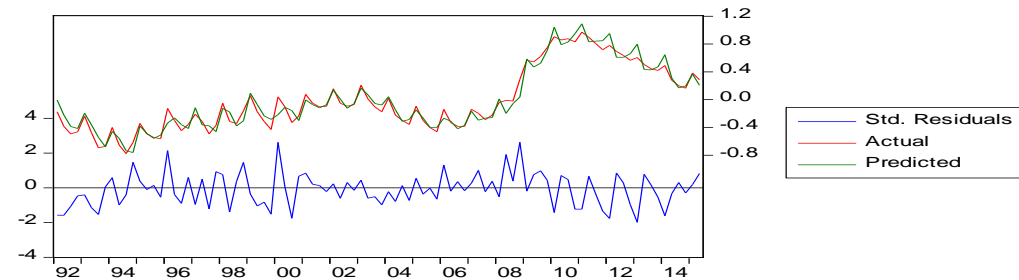
One-step-ahead Real Estate Volume Predictions



One-step-ahead Non-Real Estate Delinquency Volume Predictions



One-step-ahead Real Estate Delinquency Volume Predictions



Summary

- Leading indicator of delinquencies
- Low data requirement
- Scale up or down

Thank you

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