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USDA

United States Department of Agriculture

Latent Risk Estimation in Commercial Bank Delinquency Rates

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SCC-76 Meetings

March 18, 2016

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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:
    - $u_t^1 = u_{t-1}^1 + v_{t-1}^1 + \epsilon_t^1$ (Loan volume trend)
    - $v_t^1 = v_{t-1}^1 + \tau_t^1$ (Loan volume slope)
    - $u_t^2 = u_{t-1}^2 + v_{t-1}^2 + \epsilon_t^2$ (Delinquency volume trend)
    - $v_t^2 = v_{t-1}^2 + \tau_t^2$ (Delinquency volume slope)

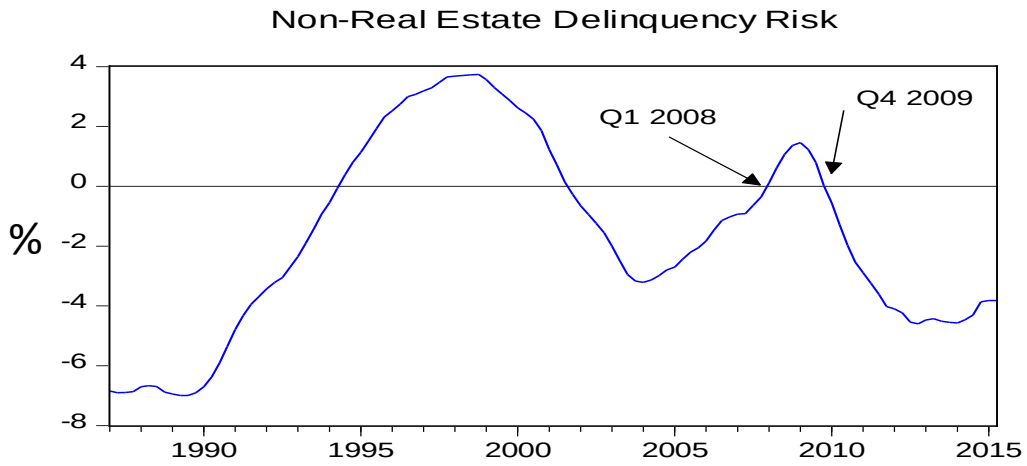
Data

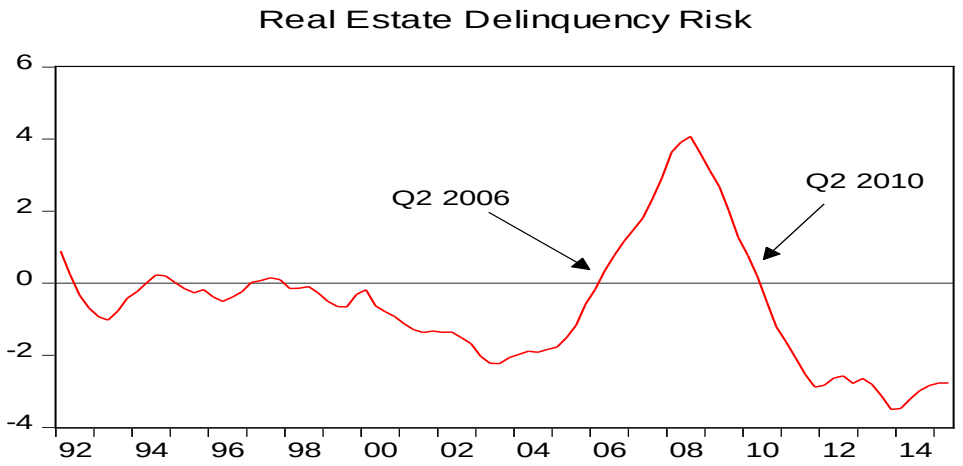
- Agricultural Finance Databook (B tables)
  - Total Loan Volume (B.1)
    - Real Estate - Quarterly, 1991 Q1 – 2015 Q2
    - Non-Real Estate - Quarterly, 1987 Q1 – 2015 Q2
  - Total Delinquent Loan Volume
    - Real Estate (B.4) - Quarterly, 1991 Q1 – 2015 Q2
    - Non-Real Estate (B.2) - Quarterly,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

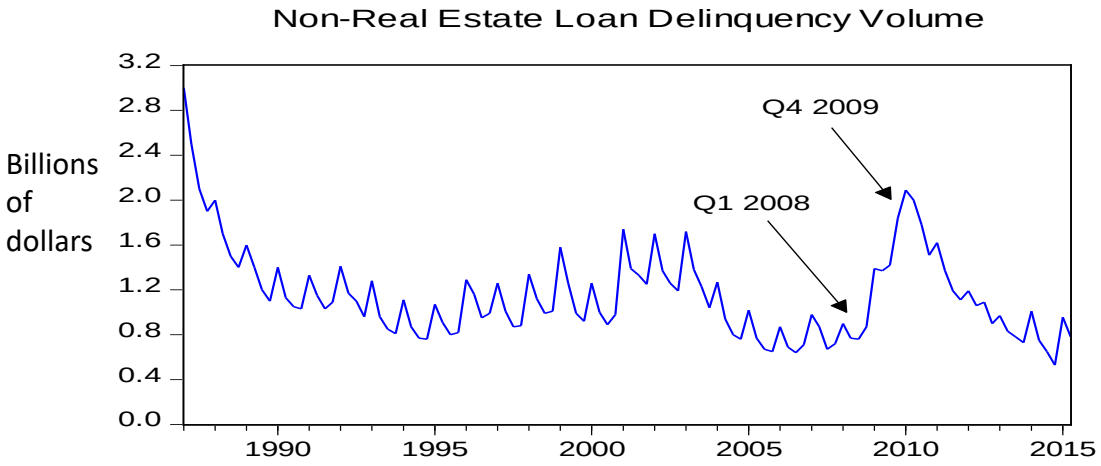
Estimation Procedure

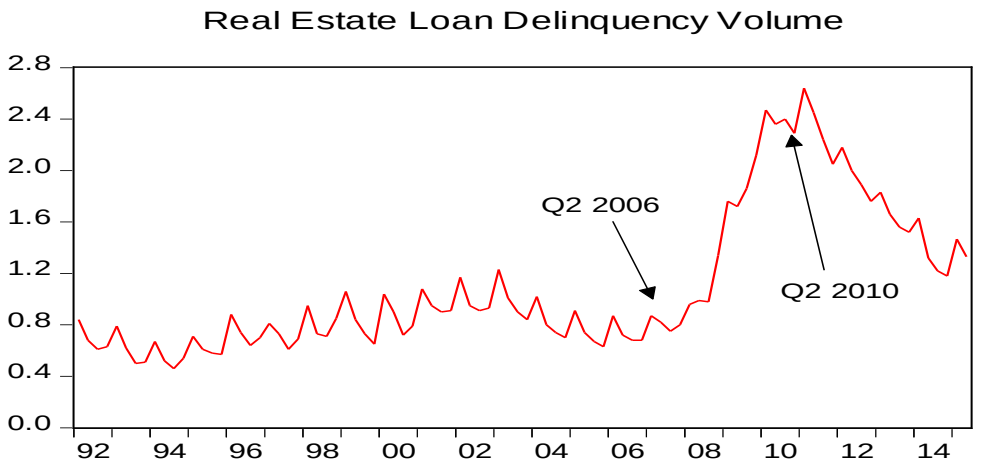
- Maximum Likelihood using BFGS non-linear optimization algorithm
  - Tried Newton-Raphson and BHHH as well. Results similar.
- Solving for 9 variables plus seasonality coefficients
- Starting values randomly drawn 1000 times
  - Converged 52 times for non-real estate model
  - Converged 142 times for 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)

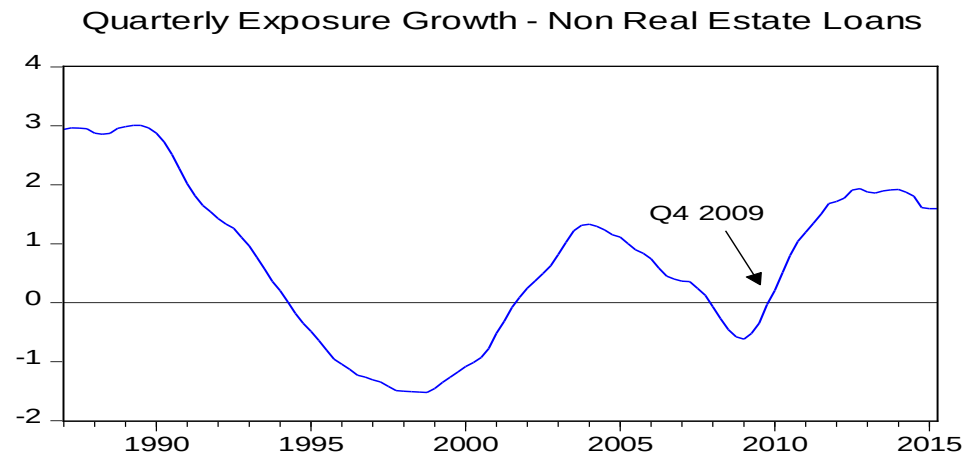


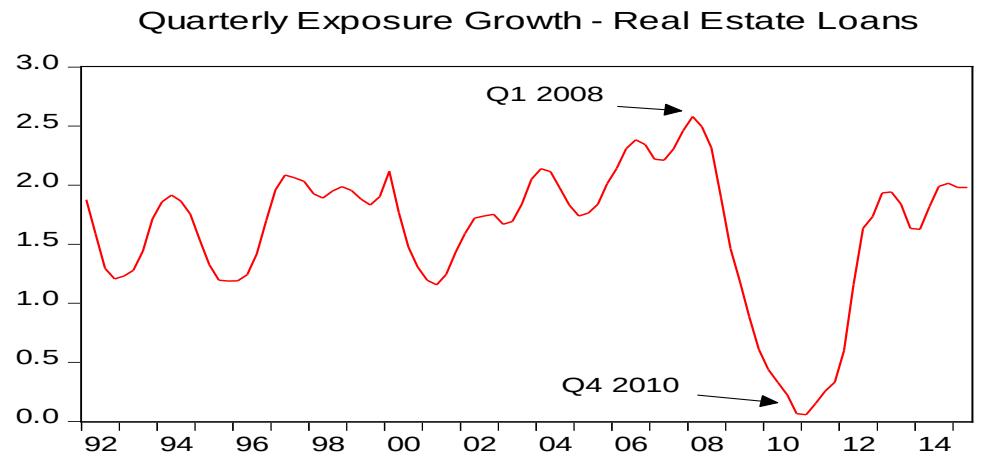


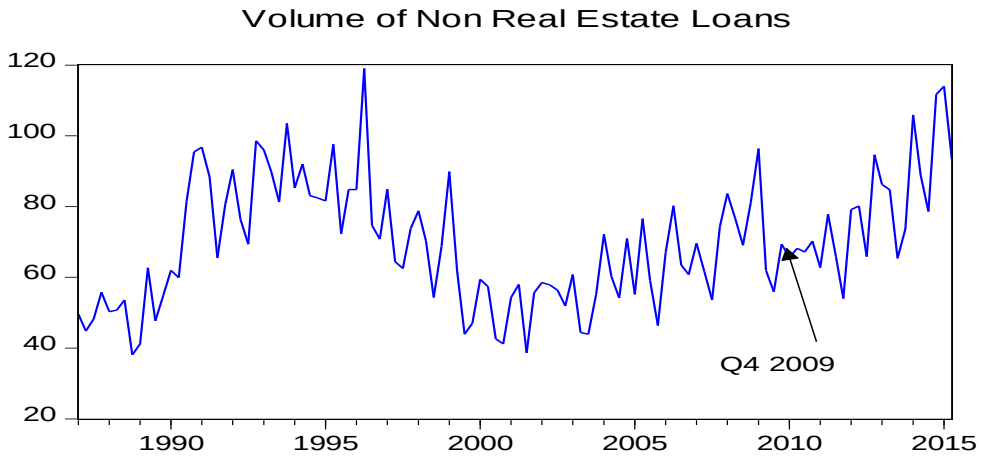


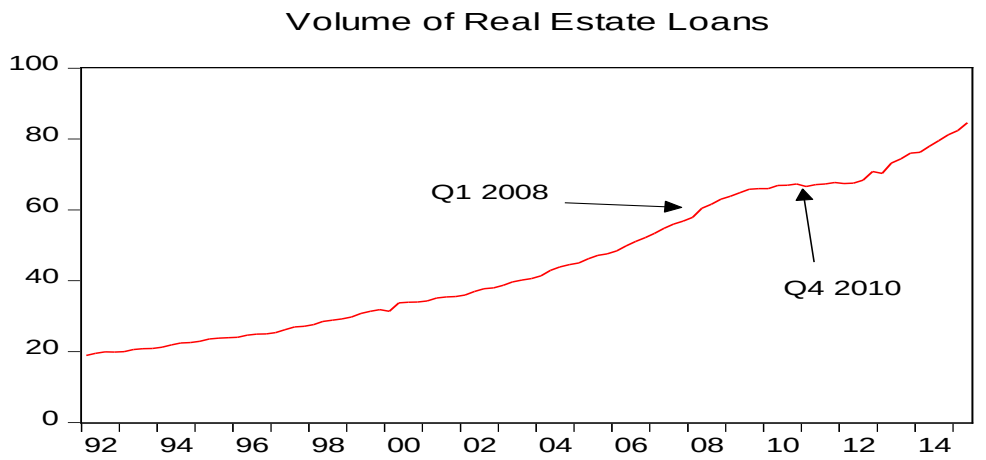


Exposure Rate (loan volume slope state variable)



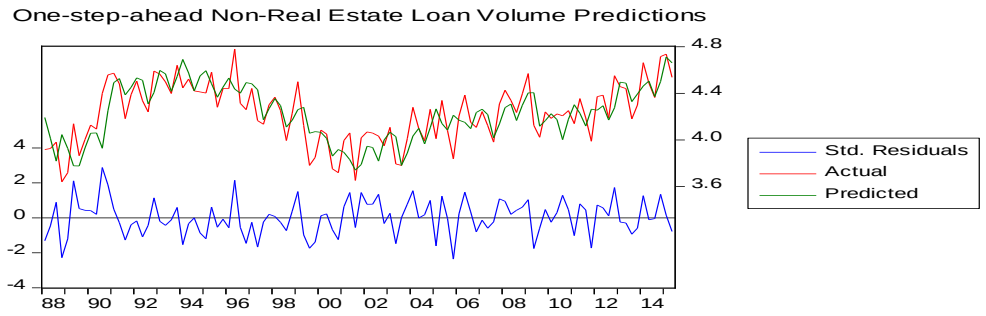


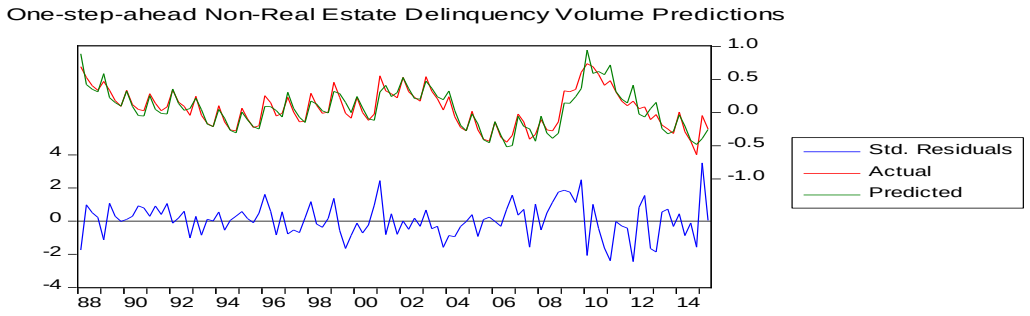




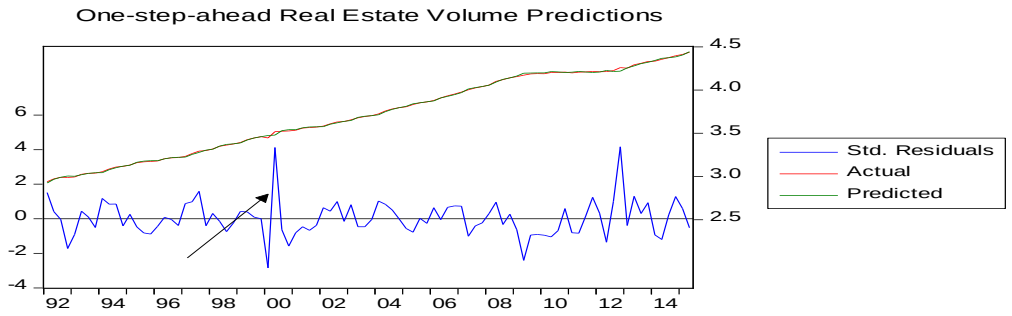
Residual Diagnostics

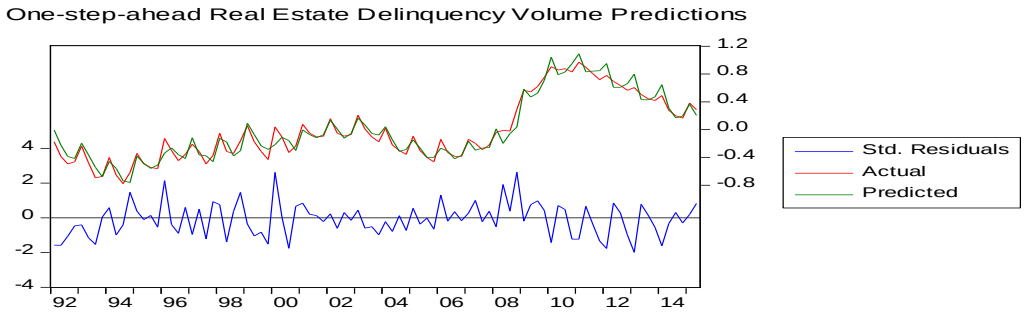
- Residuals are normal and independent for non-re estimation





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





Summary

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

Thank you

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