การจัดประชุมทางวิชาการ “*ศาสตราจารย์สังเวียน อินทรวิชัย* ด้านตลาดการเงินไทย” ครั้งที่ 18 ประจำปี 2553

การบรรยายเรื่อง
“เทคนิคทางเศรษฐมิติ AR Process เพื่อการพยากรณ์อัตราดอกเบี้ยในตลาดการเงินไทย”

ผู้บรรยาย ผู้ช่วยศาสตราจารย์ ดร.สุลักษมณ์ ภัทรธรรมมาศ

วันอังคารที่ 16 พฤศจิกายน 2553 เวลา 13:15 – 14:45 น.

ห้อง 206 คณะพาณิชยศาสตร์และการบัญชี

มหาวิทยาลัยธรรมศาสตร์ ท่าพระจันทร์

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““เทคนิคทางเศรษฐมิติ AR Process เพื่อการพยากรณ์อัตราดอกเบี้ยในตลาดการเงินไทย”

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คณะพาณิชศาสตร์และการบัญชี
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Topics

- AR Process
- Data
- Estimation Results
- Forecasts
- Limitations
- Extension
- References

AR (Autoregressive) Process

- ARMA (*p,q*) model
- Autoregressive Moving-Average Model

$$r_t = a_0 + \sum_{i=1}^{p} a_i r_{t-i} + \sum_{i=0}^{q} \beta_i \varepsilon_{t-i}$$

- If $q = 0$, the process is called AR (*p*) model.

$$r_t = a_0 + \sum_{i=1}^{p} a_i r_{t-i} + \varepsilon_t$$

- The simple concept is that part returns can explain current returns (not random walk).

AR Process- Model Selection Criteria

- How well does it fit the data?
- Adding additional lags for *p* will reduce the sum of squares of the estimated residuals.

$$\sum_{i=1}^{T} \varepsilon_i^2$$

- However, adding such lags will entails the estimation of additional coefficients and associated loss of degree of freedom.

AR Process– Model Selection Criteria

- The 2 most commonly used model selection criteria are
  - Akaike Information Criterion (AIC)
    - AIC = T ln(sum of squared residuals) + 2n
    - T = number of usable observations
    - n = number of parameters estimated (p + constant term)
  - Schewartz Bayesian Criterian (SBC)
    - SBC = T ln(sum of squared residuals) + n ln(T)
- Select the model with the *smallest* values of AIC and SBC.

AR Process–Estimation Process

- For simplicity, we assume the residuals (error terms) is normally distributed with mean zero and a constant variance.

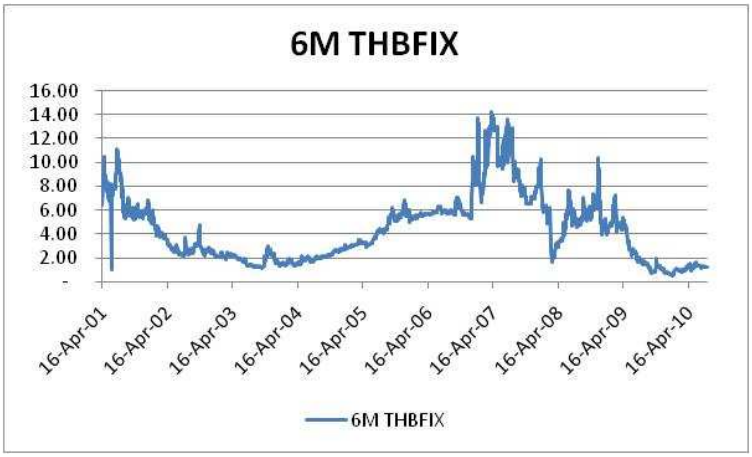
$$\varepsilon \sim N\left(0,\sigma^2\right)$$

- The AR (p) model can then be estimated with regression method.
  - Using Excel
  - Using Econometrics Software, such as Eviews

Data

- 6M THBFIX is the underlying asset of 6M THBFIX Futures
- Daily data
- In Sample Data: April 16, 2001–June 30, 2010
  - Full Sample
  - Latest 250 observations
- Out-of-Sample Data: July 1, 2010–July 30,2010

Data: Figure 1



Data: Variables

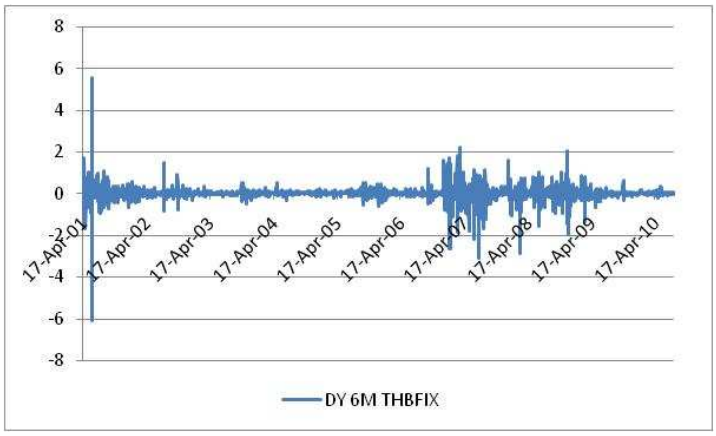
- For interest rates, we normally measure the changes in interest rates.

$$\Delta y_t = y_t - y_{t-1}$$

- The AR(p) model becomes

$$\Delta y_t = a_0 + \sum_{i=1}^{p} a_i \Delta y_{t-i} + \varepsilon_t$$

Data: Figure 2



Estimation Results: AIC and SBC

Full Data			250 Data		
Lag p	**AIC**	**SBC**	**Lag p**	**AIC**	**SBC**
1	0.7544	0.7593	1	-2.0728	-2.0447
2	0.7530	0.7603	2	-2.1091	-2.0668
3	0.7485	0.7581	3	-2.1014	-2.0450
4	0.7415	0.7535	4	-2.0941	-2.0236
5	0.7371	0.7516	5	-2.0862	-2.0017
6	0.7363	0.7532	6	-2.0784	-1.9798

Estimation Results: Estimated Parameters

Full Data		**250 Data**	
Estimated Coefficients			
a0	-0.0039	**a0**	-0.0033
a1	-0.1170	**a1**	0.1129
a2	-0.0239	**a2**	-0.2079
a3	-0.0044		
a4	-0.0396		
a5	-0.0376		

Forecasts–one period

- With the estimated coefficients, we can forecast Δy_{t+1} conditioned on the information available at period t as

$$E_t \Delta y_{t+1} = a_0 + \sum_{i=1}^{p} a_i \Delta y_{t-i+1}$$

Forecasts–multi-period

- For simplicity, consider the forecasts from the AR(1) model.

$$E_t \Delta y_{t+1} = a_0 + a_1 \Delta y_t$$

$$E_t \Delta y_{t+2} = a_0 + a_1 E_t \Delta y_{t+1} = a_0 + a_1 \left(a_0 + a_1 \Delta y_t \right)$$

$$E_t \Delta y_{t+j} = a_0 \left(1 + a_1 + a_1^2 + \ldots + a_1^{j-1} \right) + a_1^j \Delta y_t$$

- The last equation is called the *forecast function*, expresses all of the j-step-ahead forecasts as a function of the information set in period t.

Forecasts-multi-period

- Unfortunately, the quality of the forecasts declines as we forecast further out into the future.
- So, in my example, I will update the actual change every day and will do only one-step-ahead forecasts.

Forecasts: Comparison with other models

- RMSE (Root Mean Squared Error)

$$RMSE = \sqrt{\frac{1}{n}\sum_{t=1}^{n}\varepsilon_t^2}$$

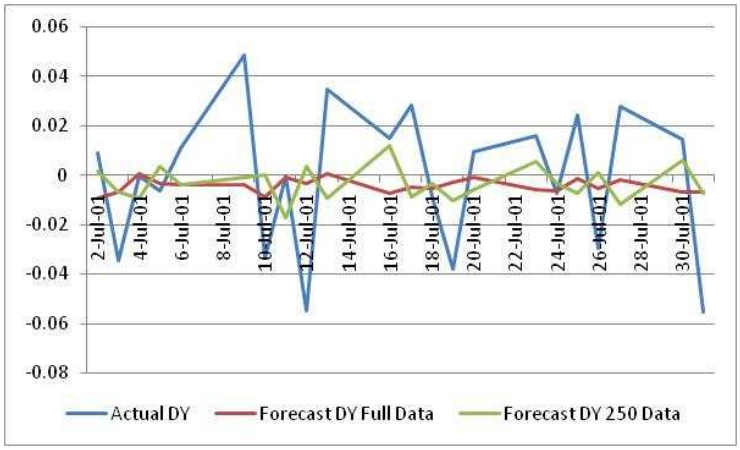
- MAE (Mean Absolute Error)

$$MAE = \frac{1}{n}\sum_{t=1}^{n}\left|\varepsilon_t\right|$$

Forecasts–RMSE & MAE

	Full Data	250 Data
RMSE	0.0278	0.0293
MAE	0.0230	0.0242

Forecast–Figure 3



Limitations of the Basic AR (*p*) models

- Only past changes in interest rates explain the current changes in interest rates.
  - Other factors are excluded.
- All estimated coefficients are assumed to be constant.
  - Time varying coefficients
  - Sensitive to the period of selected data
- Variances is assumed to be constant.
  - Time varying variance
- Residuals are assumed to be normally distributed
  - Use other distribution

Extensions

- Combine with other factors
  - ARMA (*p,q*) models
  - VAR models
  - Include other variables
- Time varying coefficients
  - Select different samples for testing
  - Use dummy variables
  - Use Markov-Switching models
- Time varying variances
  - Use GARCH type models
  - Markov-Switching model with state variance

Extensions

- Other distributions
  - Student-*t* distribution

References

- Enders, W.,2004, Applied Econometric Time Series, Wiley: USA, 2nd Edition.

Q & A