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11.433J / 15.021J Real Estate Economics
Fall 2008

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11.433 Problem Set 5: Time Series Analysis of Atlanta's Apartment Market

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December 2-11, 2008

Due December 11, 2008

The Problem and the Data

Suppose that you wish to forecast future rental housing conditions in Atlanta for a client. Suppose further that you are given the following quarterly data for the period 1985:1 to 2008:3 (The data can be found in assignments section: ATLANT_08Q3.xls).

- EMP: Total employment in the Atlanta MSA (in thousands);
- POP: Population (in thousands);
- INC: Nominal aggregate personal income ;
- STOCK: Total stock of multifamily units in 5+ structures
- PRMT: Total number of (5+) multi-family housing units permitted;
- RENT: An index of average apartment rent in Atlanta from MPF Inc. (nominal, not real dollars);
- VAC: The MSA vacancy rate (available only starting 1993:4)
- CPI: Consumer price index;

You should also construct several variables in *real dollars* (inflation adjusted) - namely RENT (call it RRENT), INC (call it RINC) and real income per worker $WAGE = RINC / EMP$.

In the data file you will find that there is a forecast through 2018:4 of the Atlanta economy in terms of the variables: INC, EMP, POP (as well as the national CPI). These incorporate a recession over 2009 as well as a recovery and are the result of a US Macro Economic Model produced by Economy.com (now a subsidiary of Moody's).

Part 1: Univariate (demand only based) forecasts

You have to make a univariate forecast of *real dollar* (inflation adjusted) rents using lagged values of rent and some economic variables reflecting demand (ex ante). This equation should look like the following.

$$RRENT_t = \alpha + \beta_0 WAGE_t + \beta_1 EMP_t + \beta_2 RRENT_{t-1} + \beta_3 RRENT_{t-2} \dots$$

(a). Note that your equation should not start until 1986:4 if (for example) you were to use 4 lags on RRENT – so as to avoid the zero value of rents in the first few periods. How many lags to include? Should they be adjacent periods or every 4th?

(b). Now with this model(s) forecast rents forward for 10 years (40 quarters). Note that this forecast is conditional on the economic outlook provided by Economy.com. What do these forecasts look like? Do rents stabilize? Grow/fall infinitely?

Part 2: Rent/Permit Bivariate structural Model.

Start by Estimating the following system of three “structural” equations:

$$RRENT_t = a + b * RRENT_{t-1} + c*EMP_t + d*STOCK_{t-1} + e*WAGE_t \quad (1)$$

$$PERMIT_t = a + b * RRENT_{t-n} + c* PERMIT_{t-4} \quad (2)$$

$$STOCK_t = STOCK_{t-1} + PERMIT_{t-4} \quad (3)$$

The last of these equations of course is simply an identity and not a statistical model. WAGE is again the *real* value of personal income/employment. In this model the 4-period lag on permits in equation (2) accounts for the seasonality of the latter. Permits in each quarter are best related to the same quarter a year ago. Rent, however does not seem to have any seasonality.

(a): From the first equation, how many units per additional thousand workers does it take to keep RRENT constant? Does this seem reasonable given the definition of the stock? What is the sign on the wage variable? Why?

(b). Now with this model system of equations forecast rents, permits and stock forward for 10 years (40 quarters). Note that this forecast is again conditional on the economic outlook provided by Economy.com. What do these forecasts look like in comparison to the previous model?

Part 3: Back testing.

Here, you will re-estimate the models above using *only the data from 1985:1 through 2003:3*. Then you will generate a 5-year forecast with each model for the period 2003:3 through 2008:3.

In each case you use the actual values of EMP and WAGE over the forecast period. This is a test of which model best captures how the economy drives the Atlanta Apartment market.

a). How close does each come to forecasting actual 2008:3 real rent levels?

Part 4: Alternative Scenarios with different economic outlooks.

Here, you will ascertain a “worst-worst” case for your client – based on a dismal outlook for Atlanta’s economy in reaction to the US financial crisis.

1). Generate a new forecast for Atlanta that assumes the current forecasts for INC and EMP (and WAGE) hold for the next 12 months (through 2009.3). Thereafter assume that the EMP *grows at only 1% annually* and WAGE also grows at the rate of *1% annually* (from dismal productivity).

2). With this bleak economic outlook generate forecasts using the second (Bivariate) model – how does this compare with the forecast using the Economy.com outlook?