University of Illinois — Department of Economics
Spring 2006 — Econ 471 — Roger Koenker

Problem Set 4
Dynamic Models and Causality
Due: April 11

This problem set combines two topics, the first part of the problem set is based on the celebrated paper by Thurman and Fisher (1988) which resolved the longstanding scientific dispute over "which came first: the chicken or the egg?" The second part deals with a dynamic version of the gasoline demand model considered in problem set

I. The data for the first part of the problem set was kindly provided by Thurman, consists of annual time series 1930-1983 for U.S. egg production in millions of dozens and the December 1 USDA estimate of the US chicken population, (excluding broilers). Unfortunately, as provided, the data seems to be slightly different than that analyzed by Thurman and Fisher. As a result your results based on the problem set data can be expected to vary somewhat from those reported in the Thurman and Fisher paper. The data is provided on the class web page as `eggs.txt`.

1. Using `granger()` try to reproduce the results of Thurman and Fisher's Table 1. Explore, as they did the effect of choosing different lag lengths to see how this influences the results.

2. Test each series for $I(1)$ behavior using the augmented Dickey-Fuller test. You may use the `adf()` function for this purpose, but again look closely to see how it works. Note that your results here may depend on the length of the lag you specify in the ADF test. How do your results here influence your interpretation of the findings in question 1?

3. Given the the results of the ADF tests try repeating the Granger test on the first differences of the chicken and egg series to see whether that changes the results.

II. The second half of this problem set deals with a dynamic version of our earlier gasoline demand model, and uses the same data set as for problem set 2.

A general dynamic model for the demand for gasoline is

$$y_t = \alpha_0 + (\alpha_1 y_{t-1} + \sum_{j=1}^{r-1} \delta_j \Delta y_{t-j}) + x_t \beta + \sum_{j=0}^{s-1} \gamma_j \Delta x_{t-j} + u_t \tag{1}$$

where *all variables are in natural logarithms,* $\Delta y_t = y_t - y_{t-1}$, and

y_t = per capita personal consumption on gasoline in thousands of gallons (at annual rates)

$x_t' = (z_t, p_t)$

z_t = per capita personal income (in 1000's of 1982 \$ at annual rates)

p_t = real price/gallon of gasoline in 1982 \$ (1 gallon = \$ at 1982 prices)

1. Estimate model (1) with $r = 2, s = 2$, and use Schwarz's BIC criterion to simplify the model.

2. Compute the long-run income and price elasticities corresponding to your final model. Compare with results you would get from the simple static model with $\alpha_1 = 0$, and $\delta_j = \gamma_j = 0$ for all j. Try to interpret the differences. What revenue implication do these long run elasticities have for contemplated increases in the gasoline tax. If the current tax rate is 30 cents per gallon, what would be the net per-capita revenue gain expected from the imposition of an additional 50 cent per gallon tax?

3. Plot the impulse response functions for your final model for both income and price changes. Interpret.