Theory and Applications for Econometrics

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December 2, 2010

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Problem Set #2

1 Theory

1. Consider a partitioned regression model of the form $\boldsymbol{y} = \boldsymbol{X}_1\boldsymbol{\beta}_1 + \boldsymbol{X}_2\boldsymbol{\beta}_2 + \boldsymbol{u}$ where $\boldsymbol{X}_j$, j=1,2, are $(n \times k_j)$ matrices and the coefficients $\boldsymbol{\beta}_j$, j=1,2, have the corresponding dimensions. For simplicity you may assume that $k_2 = 1$ (assuming $k_1 = 1$ does not make the problem easier!) Using the properties of the projection matrices $\boldsymbol{P}_j \overset{\text{def}}{=} \boldsymbol{X}_j \left(\boldsymbol{X}_j^\top \boldsymbol{X}_j\right)^{-1} \boldsymbol{X}_j^\top$ and $\boldsymbol{M}_j \overset{\text{def}}{=} \boldsymbol{I}_n - \boldsymbol{P}_j$ show that the least squares estimator of $\boldsymbol{\beta}_2$ can be obtained as follows: (a) estimate a regression of $\boldsymbol{y}$ on $\boldsymbol{X}_1$ and save the residuals, say $\widehat{\boldsymbol{u}}_1$, (b) estimate a regression of $\boldsymbol{X}_2$ on $\boldsymbol{X}_1$ and save the residuals, say $\widehat{\boldsymbol{u}}_{21}$, (c) estimate a regression of $\widehat{\boldsymbol{u}}_1$ on $\widehat{\boldsymbol{u}}_{21}$; the estimator from this last regression is the one you are looking for.

   HINT: note that $\boldsymbol{M}_j\boldsymbol{X}_j = \boldsymbol{0}$; what does $\boldsymbol{M}_j\boldsymbol{y}$ equalts to? what does $\boldsymbol{M}_j\boldsymbol{X}_s$ equals to (for $j \neq s$)?

2 Application

In the file *productivity.csv* you will find quarterly data on U.S. manufacturing productivity (per hour), real cost of production (per hour), the unemployment rate and producer prices, from 1987:Q1 to 2008:Q4.

1. Compute the quarterly growth rates (log-differences) for all series and plot them.

2. Compute descriptive statistics for the above four series.

3. Compute the correlation matrix of the four series and interpret the corresponding pairwise correlations.

4. Generate seasonal (quarterly) dummy variables, one for each quarter.

5. Estimate a static multiple regression model for the growth rate of real cost of production on the growth rates of productivity, of unemployment and producer price inflation. Test the individual and joint significance of your estimates and comment on your results.

6. Perform standard residual diagnostic tests for autocorrelation, heteroscedasticity and normality of your residuals. Comment on your results.

7. Split your sample into two parts, one part from 1987:Q1 to 1999:Q4 and another part from 2000:Q1 to 2008:Q4. Repeat the analysis of the previous two questions and comment on your results.

8. Write a short summary of your results so far, stressing the interpretation of your findings.