

ID No. \_\_\_\_\_

## Essay Exam For Economics Comprehensives, 2011

This exam is based on the following paper by Alexander J. Field, (2010) "Procyclical Behavior of Total Factor Productivity", Journal of Economic History, 70(2):326-350. The Adobe Acrobat version of this paper, posted in the Commons, is searchable. Do not open any files other than the pdf version of the paper, the Excel and Stata data sets, and NormalDistribution.xls, and do not open any software other than Excel and Stata during the exam. ON THE COMPUTER PORTIONS OF THE EXAM, SAVE YOUR WORK FREQUENTLY.

There are sections for each Micro, Macro, and Econometrics.

### Micro Section

The 15 questions below are equally weighted. All questions assume a Cobb-Douglas production function given by:  $Y = A \cdot L^\alpha \cdot K^\beta$  unless otherwise specified. Show your work if calculations are required.

Field talks about the negative relationship between TFP and changes in the unemployment rate. The concept of TFP is primarily a macro idea, but we can get general insight into the issue by looking at standard microeconomic theory.

1. In *general* mathematical terms, define the average and marginal products of labor.

MPL = \_\_\_\_\_

APL = \_\_\_\_\_

2. For the *specific* functional form above, derive the average and marginal products of labor.

MPL = \_\_\_\_\_

APL = \_\_\_\_\_

3. Set up the input profit-maximization problem for the short run (that is, assuming capital is fixed), given output price  $p$ , wage  $w$  and rental rate  $r$  and derive the first-order condition(s) for the problem above and explain what you would do to find the firm's demand for labor function. (You do not need to solve for it.)

4. What is the nature of the relationship between the firm's inverse demand for labor, the MPL and the APL? Use an appropriate diagram to illustrate your answer.

5. How are the inverse demand curves different between a firm that is a perfect competitor in the output market and a firm that has monopoly power in the output market? Be specific.

6. In your micro textbook, Prof. Barreto tells you, "On the output side, the supply curve is the MC curve when  $P > AVC$ ...The supply curve has a tail where the quantity supplied is zero when the price falls below AVC. There is a similar tail on the demand curve for labor."

What does he mean by a "similar tail", and what is the reason for this? You should produce both a mathematical and a graphical explanation. (Refer to the diagram you drew for number 4, above, in your answer, if you like.)

7. Explain, using a supplementary diagram, why the long-run labor demand curve is more elastic than the short-run demand for labor.

\*\*\*\*Open the Excel file Comps2011.xlsx. Save the data set in your own folder in the Commons and name it *Comps2011yourIDnumber.xlsx*. You will submit this file to the proctor of your exam, and it is ESSENTIAL that you only put your ID number on all files, and do NOT put your name on any of the files, in order to preserve anonymity.\*\*\*\*

8. In his paper, Field discusses the changes over time in total factor productivity. In micro, this is measured by the scalar  $A$  in the standard production function. (In micro we referred to this as “technology” which is indeed one source of increases in TFP.) All the exogenous variables, including  $A$ , for the long-run input profit maximization are provided in the Excel sheet.

9. Enter the formulae for Profits, Revenues, and Costs (cells B25-27) as well as for the Distribution of Revenues variables and Average Product of Labor (cells B31-33, C31-33, and C35). .

10. Solve for the profit-maximizing level of  $L$  and  $K$  and report them below:

$L^* =$  \_\_\_\_\_

$K^* =$  \_\_\_\_\_

Average Product of Labor = \_\_\_\_\_

What do you notice about the distribution of revenues to labor and capital? Explain briefly.

11. Proceed to the sheet titled Price Drop. Suppose that a recession occurs that results in a drop in the product’s price to \$1.75. Use Excel to show what happens to the employment and to APL. Report your answer below.

APL = \_\_\_\_\_

Is the change in labor productivity counter or procyclical? (Circle one.

In a couple of sentences, explain the economic logic behind the change in the APL.

12. Proceed to the sheet Change in  $A$ . Use this sheet to calculate the TFP elasticity of labor demand for the range  $A=30$  to  $31$ .

Report your answer here: \_\_\_\_\_ and interpret it in one or two sentences.

13. Field reports that the elasticity of TFP growth with respect to a change in the unemployment rate is about  $-0.9$ . What does this mean? Explain carefully.

14. Field explains the TFP findings as resulting from demand shocks as well as “short-run increasing returns to scale, as hotels, warehouses...and other capital assets experiences higher load factors”.

The textbook definition of returns to scale, however, is a long-run phenomenon. Explain precisely what increasing returns to scale is, why it is a long-run phenomenon, and accompany your answer with an appropriate diagram.

15. What do you think Field means by “short-run increasing returns to scale”? How would this phenomenon manifest itself in the standard Cobb-Douglas production function?



4. Explain clearly how the parameter  $\alpha$  in the equation on page 333 is related to long run growth.

5. What is the main reason for the procyclical behavior of TFP according to this author? What other possible explanations does he bring up and refute? Make sure that you clearly list them and give a short explanation of each of them.

6. What is the RBC program? Why does the author dismiss it as a possible explanation for procyclical behavior of TFP?

7. Use the AD-AS framework to show what RBC positive shocks would suggest about output, unemployment and price level. Make sure that you clearly label your graph. Provide a brief verbal description of the initial situation and the effects of such shocks.

8. Considering the oil shocks of 1970s, the author suggests an active role of monetary policy in the dynamics of the recessions. What was the role of this policy? Show the effects of both the oil shocks and the monetary policy reaction to them within the IS-LM model. Make sure you clearly label all the elements of the graph. How does the author come to this conclusion? Do you find it plausible? Explain.



9. The author of the article is talking about the central bank “leaning against the wind”. What does this expression mean in terms of monetary policy? Please illustrate such a monetary policy within the AD-AS framework in reaction to fiscal easing (expansionary fiscal policy).

## Econometrics Section

Now consider the empirical results of the paper.

1. Give a clear, concise interpretation of the coefficient estimates in regression (1.1) in Table 1 of the paper. Are the coefficient estimates statistically significant? Explain. Write down the p-values associated with each coefficient below (use NormalDistribution.xls).

2. Compare the  $R^2$  values in table 1 for regressions 1.1 and 1.2 Give interpretations for these two values. Does a higher number indicate that the model is a better fit? Explain.

3. Explain the difference between SD (standard deviation) and SE (standard error).

4. In your Eco253 Econometrics course, you frequently ran Monte Carlo simulations, of say 10,000 repetitions, and got the mean and SD of an empirical histogram generated by those 10,000 repetitions. Explain the relevance of the empirical histogram and its mean and SD. How are they related to hypothesis testing?

5. Define what is meant by autocorrelation. Does the author address the issue of autocorrelation in the estimation? Explain.

6. How would the problem of unaddressed autocorrelation affect your OLS estimates and your hypothesis testing? Explain clearly.

Now move onto the data set. Go to the Commons folder and retrieve the Stata file Comps2011.dta. Save the data set in your own folder and name it *Comps2011yourIDnumber.dta*. Open it and begin a log titled *LOGyourIDnumber.smcl* and save the log in your own folder. You will submit both these files to the proctor of your exam, and it is ESSENTIAL that you only put your ID number on all files, and do NOT put your name on any of the files, in order to preserve anonymity.

\*\*\*\*\*DO NOT FORGET TO START A STATA LOG BEFORE YOU TYPE IN ANY STATA COMMANDS. FAILURE TO DO SO MAY RESULT IN A DEDUCTION OF POINTS FROM YOUR EXAM SCORE.\*\*\*\*\*

This data set contains the raw data for Total Factor Productivity and the Unemployment Rate. You will need to create variables for  $\Delta \ln TFP$  and  $\Delta UR$ . Here are some Stata commands you will need to use.

First of all, you must tell Stata that this is a time series data set. Type in:

**tsset year**

To create the natural log of TFP

**generate lnTFP = ln(TFP)**

(This command will create a new variable called lnTFP.)

To create the first difference

**generate delta lnTFP = lnTFP - L.lnTFP**

(This command will create a new variable called delta lnTFP, and L. indicates a lag of the first order.)

To create the first difference of unemployment rate

**generate deltaUR = UR - L.UR**

(This command will create a new variable called deltaUR.)

To run an OLS regression:

**regress delta lnTFP deltaUR**

(The general format of the command for OLS regression is **regress dependentvariable independentvariables, options**)

7. Estimate regression equation (1.11). Write the coefficient estimates and t-statistics of the regression output in the space below. (Note: due to a small difference in data construction, your estimates will be slightly different from those in the paper. Qualitatively, the results should be the same though.)

8. Write down the value of the F-statistic from your estimation of regression (1.11) in the space below. Write down the null and alternative hypotheses associated with this F-statistic and conduct the F-test. What is the p-value associated with this statistic? (Use the F-dist worksheet in the NormalDistribution.xls workbook.) What is your conclusion?

9. Test for the presence of autocorrelation by using the Durbin Watson test. Write down the null and alternative hypotheses, use Stata to calculate the DW test statistic and write it in the space below. What do you conclude about the presence of autocorrelation in regression equation (1.11)?

The Stata command to conduct the DW test is

**dwstat**

NOTE: You MUST type this command directly after you run the regression question #7. Write down the value of the DW statistic below. What do you conclude from the test?

10. What is one drawback to testing for autocorrelation using the DW test? Explain briefly.

11. Let's now investigate the possibility of a significant structural change in the relationship between Total Factor Productivity and the Unemployment rate. Consider two time periods: 1900-1948 and 1948-1973. You want to test the null hypothesis that there was no structural difference between the two time periods, versus the alternative hypothesis that there was a significant structural change between the two time periods.

Construct a dummy variable called DV that takes on a value of zero in the period 1900-1948 and a value of 1 in the period 1948-1973 using the following commands.

**generate DV = 0**  
**replace dv=1 if (year>=1900)&(year<=1948)**  
**drop if year <=1899**  
**drop if year >1973**

Run the following regression

$$\Delta \ln TFP = \alpha + \beta \Delta UR + \delta DV + \mu$$

**regress delta lnTFP deltaUR DV**

12. Write the coefficient estimates of this regression output in the space below. Be sure to report the relevant t-statistic and p-value for your hypothesis test. What do you conclude about your test?