ID No. _____

# 2010 Economics Written Comprehensive Exam, Part 2

This exam is mostly based on two papers: Holmstrom, Bengt and Jean Tirole, (1993) "Financial Intermediation, Loanable Funds, and the Real Sector," *Quarterly Journal of Economics*, 102(3): 663-691 and Bernanke, Ben S., (1983) "Nonmonetary Effects of the Financial Crisis in the Propagation of the Great Depression," *American Economic Review*, 73(3): 257-276. The Adobe Acrobat versions of the papers in the Commons folder of Caleb.Courses/Fall 2009/Econ 401 are searchable. Point values are given in parentheses—the entire exam is worth *** points.

**You will probably want to write part of the exam on paper and part in the Word version of this exam. On the paper copy please indicate which questions are in the Word document.**

Please save this file to your Econ 401 folder as

EmpiricalCompsYourNumber.doc.

For example if your number is 2, save the file as EmpiricalComps02.doc. If your number is 16, save the file as EmpiricalComps16.doc.

In general, give your answers in clear prose, using words rather than symbols. If you mention an equation make sure than you explain each and every term in the equation in words.

**Part 1: Bernanke (1983)**

We used a data set that is slightly different from the one in Bernanke (1983). In particular, our data set includes the producer price index instead of the wholesale price index used by Bernanke, there are some differences in seasonal adjustment, and we used some different sources. Therefore, your results will be slightly different but still comparable to those in Bernanke.

You will find the STATA file that contains the data for your work in the Commons folder of Econ 401. It is called BernankeReplication.dta. Open the file and go to File, Log, Begin and save your log of the session in your folder under the name EconCompsLogXX.smcl where XX is your comps ID number. This way we can check what you actually did.

1. Open the data editor and calculate descriptive stats (command: 'sum') to familiarize yourself with the data. The price level and industrial production are index numbers, and money supply is in millions of dollars. We have already prepared the variable y; as in Bernanke, it refers to the rate of growth in industrial production relative to trend.

2. (5) Calculate growth rates for money supply m and for price level p (inflation rates). Name the growth rate for money supply "mongr" and inflation rates "infl". The growth rate of a variable $x$ in percentage points can be calculated as follows:

$$xgr = \left( \frac{x_t}{x_{t-1}} - 1 \right) \times 100$$

In STATA we write this as follows:

**gen xgr=((x/L.x)-1)*100**

Notice that in STATA you replace $x_{t-1}$ with 'L.x', which stands for the variable $x$ lagged one period. Similarly, L2.x in STATA stands for $x_{t-2}$ and L3.x stands for $x_{t-3}$.

Thus when computing the growth rate in prices, write:

**gen infl=((p/L.p)-1)*100**

When computing the growth rate in money write:

**gen mongr=((m/L.m)-1)*100**

**Save the data set to your folder as compsdataXX.dta where xx is your ID no.**

3. Focus only on the crisis years of 1930-1932.

a. (5) Prepare a graph showing inflation rates through time for this period. The STATA command

**line infl time if tin(1930-1,1932-12)**

produces such a graph. **Save the graph** into your folder as infl30-32.gph. (Use File: Save Graph.)

Were the growth rates of the price level in 1930-32 mostly positive or negative? What is this phenomenon called? Imagine that the data represents consumer price indices. What would this imply for what happened to the cost of living in 1930-32? Explain briefly.

b. (5) Prepare a graph showing the deviations of growth rates of output from their trend (this is just your variable y) through the same period (1930-1932). The STATA command is

**line y time if tin(1930-1,1932-12)**

**Save the graph** into your folder as outputgrowthrates30-32.gph. (Use File: Save Graph.)

Did output during 1930 – 1932 grow faster or slower than the average for the whole period of 1919-1941? Would this imply deviations to the left or to the right from potential output in the AD-AS framework?

c. (5) Imagine that deviations from potential output in part *b* above are solely due to negative shocks to AD. Given deviations in *b* above for output, would the dynamics of the price level described in part *a* above be surprising? Why or why not? Draw an AD-AS graph that illustrates effects of such negative AD shocks on both output and the price level in the short run.

4. Consider equation (1) on p.269 of Bernanke's paper. Ignoring the lagged (those from previous periods) variables, it shows the relationship between dynamics of output and money supply.

a. (5) Given that this equation includes changes in monetary policy, would this equation be a representation of AD or of AS? Explain briefly.

b. (5) Give a careful interpretation for the $(M\text{-}M^e)$ regressor. In particular, tell exactly what $M^e$ is. Then explain what is the deviation of actual $M$ from $M^e$. Is this an AD or an AS shock?

c. (5) Bernanke explains that he calculates ($M$-$M^e$) by regressing "mongr" on 4 lags of "mongr", 4 lags of "infl", and 4 lags of "y". Then he takes the difference between the actual value and the predicted value, which is the residual, to be ($M$-$M^e$). So there are two steps to do: (i) run a regression of mongr on L.mongr, L2.mongr, L3.mongr, L4.mongr, L.infl, L2.infl, etc. (ii) Then collect residuals in a new variable. Give this variable the name mme.

The first step corresponds to the following STATA command:

**reg mongr L(1/4).mongr L(1/4).y L(1/4).infl**

(Here L(1/4).mongr stands for regressors at times t-1, t-2, t-3 and t-4 for variable mongr – 4 lags of mongr)

and the second step corresponds to the following STATA command:

**predict mme, resid**

This collects the residuals–the difference between actual and predicted/expected values – in the variable mme. Now you have the ($M$-$M^e$) regressor ready.

**Save your data**.

5. Turn your attention now to equation (2) on p. 269 of Bernanke's paper. It will be easier if you ignore the lags.

a. (10) This equation represents a particular form of the AS relationship. What is it called? What are a few reasons why a nominal variable ($P$-$P^e$) might affect real output?

b. What happens to output if the actual price level is higher than the expected one? In other words, what is the expected sign for the coefficient on ($P$-$P^e$)? Why? Draw an appropriate AD-AS graph to illustrate the effects of an increase in ($P$-$P^e$) in both the short run and the long run.

c. (5) In the same manner as above in *5c*, Bernanke calculates the ($P$-$P^e$) shocks in two steps:

(i) run a regression of infl on L.mongr, L2.mongr, L3.mongr, L4.mongr, L.infl, L2.infl, L3.infl, L4.infl, L.y, L2.y, L3.y, and L4.y:

**reg infl  L(1/4).mongr  L(1/4).y L(1/4).infl**

(ii) Then collect the residuals in a new variable. Give this variable the name ppe:

**predict ppe, resid**

**Save your data**.

6. Now you are ready to run regressions similar to those on Bernanke's p. 269. You will find the equivalent of equation (1) as follows:

**reg y L(1/2).y L(0/3).mme**

Run this regression. Ignore coefficients on the lagged values of output.

a. (5) Carefully interpret the meaning of the estimated coefficient of $(M - M^e)_t$ in equation (1). (This is the coefficient on the contemporaneous term for mme—0 lags.)

b. (5) Do your results suggest that positive monetary shocks (surprise increases in the growth rate of money) have an expansionary effect on output? Explain briefly.

c. Bernanke summarizes the monetarist version of the causes of the Great Depression:

> "Among explanations that emphasize the opposite direction of causality [that developments in the financial system caused declines in aggregate output], the most prominent is the one due to Friedman and Schwartz. Concentrating on the difficulties of the banks, they pointed out two ways in which these worsened the general economic contraction: first, by reducing the wealth of bank shareholders [ignore this reason]; second, and much more important, by leading to a rapid fall in the supply of money." (p. 257)

Are the coefficients on the $(M - M^e)$ variables consistent with a monetary explanation for the Great Depression? Explain. (Hint: Did money supply during this period grow faster or slower than expected? What would be the consequences for output according to the monetary explanation? )

7. Now run the following command to obtain the equivalent of equation (2).

**reg y L(1/2).y L(0/3).ppe**

a. (5) Consider the output of this regression. Which coefficients are statistically significant? What does "statistically significant" mean?

b. (5) Does the sign of the coefficient on $(P\text{-}P^e)_t$ correspond to your answer in *5b* above? Give an interpretation for the coefficient on $(P\text{-}P^e)_t$.

8. (10) Bernanke adds additional terms to equations (1) and (2) to obtain equations (3) and (4). What do these additional terms represent? How does he interpret the results given in equations (3) and (4)? Why are they important to his argument? In what way do these additional terms affect the dynamics of output?

Make sure that you **save your data** and that you close your log file before exiting from STATA.

9. On p. 263 Bernanke says:

> "Let us suppose that savers have many ways of transferring resources from present to future, such as holding real assets or buying the liabilities of government or corporations on well-organized exchanges. One of the options savers have is to lend resources to a banking system."

But agents have to decide how much they wish to transfer to the future first. Consider an agent that lives two periods. For simplicity's sake, suppose that she receives $I_1$ = \$200,000 of income in the first period (for example, over several years) and then receives $I_2$ = \$600,000 in the second period of her life. Imagine that this agent can deposit what she does not spend in the first period in a bank and receive 50% interest on her deposit and that she can borrow at the same rate against her second-period income.

a. Write down the present value of her lifetime income.

b. Write down the present value of her lifetime consumption if you consider $C_1$ to represent consumption in the first period and $C_2$ consumption in the second period.

c. Combine your results from parts *a* and *b* above into an intertemporal budget constraint.

Suppose the Cobb-Douglass utility function for this person is:

$$U(C_1, C_2) = C_1^{0.5} C_2^{0.5}.$$

d. Solve this constrained optimization problem for $C_1$ and $C_2$. Set up the constrained optimization problem for $C_1$ and $C_2$ by writing down the Lagarangean expression and writing down the relevant first order conditions. Then solve for the optimal values of $C_1$ and $C_2$. You should find that $C_1^* = 300; C_2^* = 450$.

e. How much will optimal saving or borrowing be in the first period? (HINT: you can answer this question even if you don't do all the math in part *e*.

f. On p. 267 Bernanke says:

"If this higher rate applies to household and small firm borrowing but not to their saving (they may only earn the safe rate on their savings), then the effect of higher borrowing costs is unambiguously to reduce their demands for current-period goods and services. "

Suppose that the saving rate remains 50% but the borrowing rate becomes 100%. Carefully draw a graph of the original and the new intertemporal budget constraints.

g. Is Bernanke's claim in the quote in part *g* correct? Explain your answer, referring to the graph you drew for part *g*.

**Part 2: Holmstrom and Tirole (1997)**

Accompanying this part of the test is the Excel file, HT1997Paper.xls. Save this file to your folder as HT1997yourcompsidno.xls. For example, if your number is 2, save the file as HT11997Paper02.xls. If your number is 16, save the file as HT11997Paper16.xls.

1. Let us analyze the effect of a reduction in firms' in the HT model. Suppose that all firms suffer a reduction of 20% in the amount of their own capital (A). Furthermore, to keep things simple, assume $\beta$ can change but that $\gamma$ as well as the other parameters of the model remain constant. Then we can make a strong argument that this reduction in firms' capital causes overall investment to decline.

a. (5) What happens to the number of firms which receive *direct* finance? Why?

b. (10) Suppose that the total capital of FIs remains constant. If the total number of firms receiving *indirect* finance rises, what must happen to $\beta$, the expected return to intermediary capital? Why?

c. (10) Given your answer to part *b*, what happens to $\underline{A}(\gamma, \beta)$ the minimum level of capital necessary for firms to receive indirect finance?

2. (10) Footnote 9 (p. 671) of HT says: "Firms with $A > \overline{A}(\gamma)$ are indifferent between investing the surplus in the firm or in the market for uninformed capital." Show that this is true for a particular example with a value of $A$ greater than $\overline{A}(\gamma)$, using the relevant parameter values (I = 10, $\gamma$ = 110%, B = 3 $p_H$ = 60%, $p_L$ = 35%) in the Excel workbook. This involves making numerical calculations. Show your work below. (In this case $\overline{A}(\gamma) = 5.\overline{63}$.)

3. (5) HT say: "monitoring is a partial substitute for collateral." (p. 655). How exactly does monitoring by financial intermediaries substitute for collateral?

**Part 3: Comparing the Two Papers**

Bernanke writes: "A useful way to think of the 1930-33 debt crisis is as the progressive erosion of borrowers' collateral relative to debt burdens." (p. 265)

1. (10) In HT's model why does a reduction in borrowers' (firms') collateral reduce overall investment? In your answer, you may wish to describe the comparative statics exercise in the HT1997Paper.xls *Aggregate* sheet in which you can shock firm collateral levels.

2. Compare the models of financial intermediation in the two papers.

a. (5) What is the role of financial intermediaries in HT's paper?

b. (5) What roles do financial intermediaries play in Bernanke's model (see especially p. 263) which they do not play in HT's paper?

c. (10) In Bernanke's model, why does a reduction in borrowers' (firms') collateral reduce overall investment?

3. (10) Compare and contrast the approaches of the two papers. What are the advantages and disadvantages of the approaches of the two papers?