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2013 Micro Theory Comprehensive Exam (50 pts total)

Based on Bailey and Collins: "Did Household Technology Cause the Baby Boom? "

Let the utility function of a household with income of M dollars be given by $U = N^{\alpha_N} \cdot H^{\alpha_H} \cdot Z^{\alpha_z}$, where:

Z = non-home produced goods
H = home produced goods
N=number of children
P_Z = price of Z (identically equal to 1)
P_N = price of N
P_H = price of H

Note that all of the alphas are between 0 and 1.

1) (2) What kind of utility function is this?

2) (4) Set up the Lagrangean associated with the household utility maximization problem.

3) (4) Produce the first order conditions.

4) (5) For problems 4 and 5, assume that there are only two goods, Z and N. In the space below, show conceptually the income and substitution effects associated with a fall in the price of children due to improvements in household technology. Label everything carefully. Assume that children are a normal good.

5) (5) Reproduce the figure you drew above assuming that children are an inferior good.

Returning to the original specification of the utility function, assume now that all three of the values of alpha are equal to 0.25 and that income is $300. The demand for children is given by

$$N^* = \frac{\alpha_N}{\alpha_N + \alpha_H + \alpha_Z} \cdot \frac{M}{p_N}$$

6) (2) If the shadow price of children is $20, how many children are demanded?

Suppose that a technology shock such as electrification halves the shadow price of children. Below you will be asked to use the Slutsky equation to decompose the effect of the price change.

7) (5) Find the total effect of the price change (that is, find $\frac{\Delta N^*}{\Delta p_N}$).

8) (5) Calculate the substitution effect (use the same form).

9) (5) Find the income effect.

10) (4) What is the point elasticity of demand for children at a price of ten? What does this tell you?

Consider now an alternative functional form for the demand for children given by:

$$N^* = 100 - 10 \cdot p_n + 5 \cdot p_H$$

11) (3) Are children and home-produced goods gross substitutes or complements? Why?

12) (6) If the above specification is correct, what can you say about the direction of the effect of technology on fertility as presented in equation 4 on p. 211 of the paper? Explain.

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Type your answers and save them as MacroExamIDNo.docx, with your ID number substituting e.g. MacroExam2.docx or MacroExam17.docx in the Caleb: Econ Comps 2013 folder. **Save your file to the right directory before you start working. Double-check that you're saving your file onto Caleb instead of onto the local computer's hard drive**. Put your diagrams on separate pieces of paper each with your ID number, label each Figure so that we can tell which question they belong to (e.g. Figure 2.3 would be the 3rd figure replying to question 2), and refer to that Figure number in your typed answer. Turn in the diagrams with your ID number.

1. (15 pts) The article starts as follows: "After at least 100 years of decline, childbearing in the United States increased by more than 50 percent between 1939 and 1957 (see Figure 1). This remarkable departure from longer term trends, often called the 'baby boom,' was not a short-lived, statistical aberration …" [p. 189]

Use the Solow growth model to explain the effects of the change from the quote above on long run growth, counterfactually assuming that the change was permanent. Specifically,

a. Draw a clearly labeled Solow graph and show the relevant changes on the graph.
b. Explicitly tell whether you are working with capital per effective worker or alternatively capital per worker graph (choose the one you used in your macro class/textbook).
c. Explain the elements of the graph and the effects of the changes.
d. Would the changes indicated on your graph imply that the growth rate of the steady state total output (not per worker or per effective worker) would change? Explain why or why not.

2. (10 pts) "GSV [Greenwood, Seshadri, and Vandenbroucke] cite estimates of TFP [Total Factor Productivity] growth of 1.41 percent per year from 1900 to 1948 and 1.68 percent per year from 1948 to 1974." [p. 194]

a. Explain what Total Factor Productivity, sometimes also called the Solow Residual, is.
b. Provide interpretation for the quote above and speculate about the reasons for the change.
c. Use the Solow graph to show the effect of this change on the steady state capital per effective worker (or per worker) – work with the graph defined the same way as in the previous question above.
d. What is the most likely effect of this change in the TFP growth rate on the living standard in the long run? Define the living standard and explain briefly.

3. (15 pts) The article considers improvements in household productivity as a possible source for the increase of fertility during the studied period. While it suits the specific purposes of the authors well, it is hard to imagine that these improvements in technology would be limited only to the household sector. Indeed, it is reasonable to assume that technological advances changed every aspect of the whole economy and particularly production. Draw two AD-AS graphs to illustrate the effect such technological progress would have on output and price level. In particular:

a. The first graph should show the short run effects.
b. The second graph should focus on the long run effects (What will happen to the long run aggregate supply-LRAS?).
c. Consider now the role of the monetary authority in such an economy. In particular, assume that the central bank in this setting wishes to keep the price level stable. What should it do in reaction to these shocks in order to achieve this goal?

4. (10 pts) "Becker and Robert J. Barro (1988) reformulated this static framework to allow altruistic parents to incorporate their children's utility within an intergenerational, dynastic framework." [p. 190] This is essentially an application to fertility of the argument presented in your textbooks: "According to Barro's analysis, the relevant decision making unit is not the individual, whose life is finite, but the family, which continues forever. In other words, an individual decides how much to consume based not only on his own income but also on the income of future members of his family."

a. Do Bailey and Collins find any empirical support for this "dynastic" view of economic decision making units? In other words do they find it plausible that "the perception of high child-rearing costs during the Great Depression and World War II depressed fertility and that the postwar baby boom made up for these forgone births" [p. 190]? Explain briefly.
b. This same understanding of a long lived family as an economic agent is built into the concept of Ricardian equivalence. Explain briefly what Ricardian equivalence is.
c. In what way is such conceptualization of an economic decision making subject (as infinitely lived households) related to the substantial government debt accumulated in this country? Contrast it to the world with conventional short-lived economic agents.

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Comprehensive Exams – Econometrics Portion - Class of 2013

This exam is based on the article "Did Improvements in Household Technology Cause the Baby Boom? Evidence from Electrification, Appliance Diffusion, and the Amish", *American Economic Journal: Macroeconomics* 3 (April 2011): 189–217 by Bailey and Collins. Point totals for each question are given—the total value of this portion of the test is 40 pts. *Please write legibly*.

Questions:

Interpreting coefficients

Fixed effects

Omitted variable bias

Functional form

Taking a look at the data:

Here are means, SDs, minimums, maximums and definitions of variables in the data set:

Regress fertility on state dummy variables.

Why would one suspect that there is heteroskedasticity in this regression?

Consider the result reported in Panel A of Table 2. For specification (1), the point estimate for "Percent with modern stove" is -0.428. Interpret what this coefficient means, by comparing a county in which 20 percent of the households have modern stoves with a county where 80% of the households have modrn stoves.

Use the command

Sum stove (1940)

True or false, and explain: about **% of all households in the 3014 counties had modern stoves.

Suppose that in counties with higher wages, people are more likely to buy more appliances (because they have more money). Why might this fact induce a bias in estimates of relationship between appliance ownership and fertility reported in column (1) of Table 2 (p. 198)?

Why might the inclusion of state fixed effects (reported in column (2) of Table 2) help to correct this bias?

Variable	Obs	Definiition	Mean	Std. Dev.	Min	Max
cause	70	Code for cause of death	378.11	220.134	10	999
initial3	70	Death rate, 1983-85	0.0001394	0.0003	0.0000010	0.002361
initial3per1000	70	Death rate/1000, 1983-85	0.1394	0.3384	0.000959	2.361
blkdeaths	70	Number of Black deaths, 1983-85	402.31	1159.828	1	8908
whtdeaths	70	Number of White deaths, 1983-85	905.73	2050.807	1	13238
Ninit	70	Number of births, 1983-85	9380019	0.000	9380019	9380019
final3	70	Death rate, 1996-99	0.0000945	0.000	0.0000007	0.001858
final3adj	70	Death rate, 1996-98, weight adjusted	0.0000875	0.000	0.0000007	0.001652
Nfin	70	Number of births, 1996-98	8682891	0.000	8682891	8682891
lnchg3	70	Ln (death rate 1996-98/death rate 1983-85)	-0.3885	0.552	-2.4341	0.5708
Vlnchg3	70	Variance for lnchg3	0.0243	0.056	0.0001	0.2667
lnchg3adj	70	lnchg3 adjusted for weight	-0.4461	0.559	-2.5690	0.5473
Vlnchg3adj	70	Variance for lnchg3adj	0.0246	0.056	0.0001	0.2708
articles	41	Number of journal articles published 1983-98 on cause of death	1314.9	1452.0	1	8334
grants	49	NIH grants on cause of death, 1983-98	135.7	167.4	0	776
grants75	49	NIH grants on cause of death, 1975-82	59.7	102.6	0	509

The change in the average death rate for each cause of death, from .0001394 in 1983-85 to .0000945, looks really small. However, there are 70 causes of death, so the combined infant mortality rates were:

$$IMR_{1983-85} = 70 \times .0001394 = .009758$$

$$IMR_{1996-98} = 70 \times .0000945 = .006615$$

These rates are more commonly expressed per 1000 persons, so $IMR\ per1000_{1983-85} = 9.76$ while $IMR\ per1000_{1996-98} = 6.62$. You may still think those levels are small, but consider that the death rate for 21 year olds in 2010 was about 0.96 per 1000 in 2006. Babies are almost seven times more likely to die than people your age.

1. (5 pts) Another way to measure the impact of the decline in birth rates is to compute the number of deaths which would have occurred using the 1983-85 overall death rate for the 8,682,981 non-Hispanic births that actually occurred in the 1996-98 period and compare that to the number of deaths that actually occurred in the 1996-98 period. How many infant lives were saved by this measure? Show your work. (Read the whole question again carefully. This can be answered with the information you've been provided in the paragraph above.)

Note that in the paper, the authors work with weight-adjusted death rates for the 1996-98 ("final") period. These are the death rates which we would have seen had the birth rate distribution stayed the same between 1983-85 and 1996-98. Death rates are much higher for low weight babies, and the distribution of birth weights shifted downwards between 1983-85 and 1996-98. Had birth weights not fallen, death rates would have been lower in 1996-98 than they actually were. The authors want to remove this cause of change from the analysis, and so they work with the adjusted rates.

Induced Innovation and Heteroskedasticity

The authors want to study induced innovation. To do so, they specify equation (7):

$$ln\left(d_i^1 / d_i^0\right) = \beta_0 + \beta_1 d_i^0 + \varepsilon_i$$

Here d_i^1 is the death rate for cause *i* in the later period (1996-98); d_i^0 is the death rate for cause *i* in the earlier period (1983-85). The variable lnchg3adj corresponds to the left hand side of equation (7) where the authors have adjusted for changes in the birth weight distribution; the variable initial3per1000 corresponds to d_i^0.

2. (5 pts) How would you interpret the error term in equation (7)? I.e., what kinds of influences on the decline in death rate might belong in the error term?

3. (5 pts) The authors believe that the error term in equation (7) is heteroskedastic. Why might there be heteroskedasticity in this model?

4. (5 pts) Why are the estimates obtained by correcting for heteroscedasticity preferable to straightforward OLS estimates for equation (7)?

Go ahead and replicate the result in Column 1 of Table 4 by typing the following command in Stata:

reg lnchg3adj initial3per1000 [aweight= 1/ Vlnchg3adj] if cause <999

In this command, heteroskedasticity is corrected via the [aweight= 1/ Vlnchg3adj] option and we omit the catchall category by use of the if statement at the end. For ease of reading the regression results, we use the variable iniital3per1000 instead of initial3 (the paper does this as well).

5. (5 pts) Suppose, hypothetically, that the causes of death which were associated with the highest death rates were mostly the result of air pollution and that air quality improved considerably between 1985 and 1994. Would these circumstances strengthen or weaken the conclusions of the paper? Explain your answer.

We created a new variable called chg3adj, using this command:

gen chg3adj = exp(lnchg3adj)

The exp command takes the exponent, so chg3adj is the change in the death rates between 1983-95 and 1994-96 for each individual cause of death. Run the following regression using this variable

reg chg3adj initial3per1000 if cause < 999, robust

In this regression the robust option generates robust standard errors, which is alternative method for dealing with heteroskedasticity.

6. (10 pts) Suppose the authors had run this linear regression instead of the one with the logarithmic functional form:

   reg chg3adj initial3per1000 if cause < 999, robust

   Interpret the results. Discuss both the estimate of the constant term and the estimate of the slope term.

7. (5 pts) Finally, turn to the statement on the bottom of p. 26 ("these coefficients are not statistically different from each other") and column 3 of Table 5 (where results for the F-test for equal coefficients is presented). What are the constrained and unconstrained regressions that are used for the F-test?