Department of Applied Economics Johns Hopkins University

Economics 602
Macroeconomic Theory and Policy
Final Exam
Professor Sanjay Chugh
Fall 2008
December 8, 2008

NAME: ______________________________

The Exam has a total of four (4) questions and pages numbered one (1) through thirteen (13) (followed by three blank pages). Each problem's total number of points is shown below. Your solutions should consist of some appropriate combination of mathematical analysis, graphical analysis, logical analysis, and economic intuition, but in no case do solutions need to be exceptionally long. Your solutions should get straight to the point – **solutions with irrelevant discussions and derivations will be penalized.** You are to answer all questions in the spaces provided.

You may use two pages (double-sided) of notes. You may use a calculator.

Question 1	**/ 15**
Question 2	**/ 15**
Question 3	**/ 28**
Question 4	**/ 42**
TOTAL	**/100**

1. **A National Service Program (15 points)**. Consider the following radical policy proposal: rather than taxes being levied on individuals and the proceeds of those taxes being used by the government to fund various programs, suppose that every individual pays no taxes of any kind but must give ten hours of his time every week to national service. Here you will analyze this national service program in the context of the (one-period) consumption-leisure model we have studied. Thus, there are now **three** uses of the individual's time: work, leisure, and national service (the mandatory 10 hours). **Assume the following:**

   - Instituting the national service program has no effect on any prices or wages in the economy.
   - Any time spent voluntarily performing national service beyond the required 10 hours is considered leisure.

a. **(8 points)** Using the notation we developed in Chapter 2 (i.e., c to denote consumption, n to denote hours of work per week, l to denote hours of leisure per week, P to denote the nominal price of consumption, and W to denote the nominal hourly wage), construct the representative agent's (weekly) budget constraint in this model with a national service program. Recall that there are 168 hours in one calendar week. Provide brief economic justification for your work.

b. **(7 points)** Now recall the standard consumption-leisure model with no national service program and suppose that both the consumption tax rate is zero and the labor tax rate is zero. How does the slope of the budget constraint in this economy compare with the slope of the budget constraint in the economy with the national service program in part a? Provide brief economic intuition.

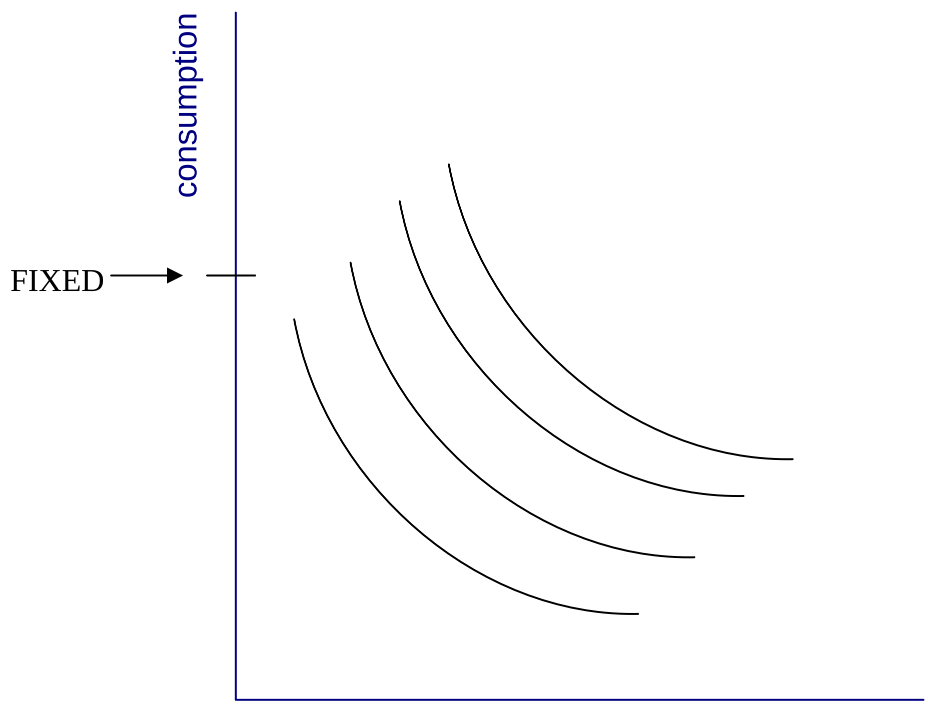
2. Monetary Policy in the MIU Model (15 points). In this question, you will analyze, using indifference curve/budget constraint diagrams, the implications of alternative nominal interest rates on the representative consumer's choices of consumption and **real** money balances.

Recall that, with an instantaneous utility function $u(c_t, M_t / P_t)$ (where, as usual, c_t denotes consumption and M_t / P_t denotes **real** money balances), the consumption-money optimality condition (which we derived in Chapter 14) can be expressed as

$$\frac{u_{m_t}(c_t, M_t / P_t)}{u_{c_t}(c_t, M_t / P_t)} = \frac{i_t}{1+i_t},$$

where, again as usual, i_t is the nominal interest rate, $u_c(.)$ denotes the marginal utility of consumption, and $u_m(.)$ denotes the marginal utility of **real** money balances.

a. **(5 points)** Suppose the central bank is considering setting one of two (and only two) nominal interest rates: i_t^1 and i_t^2, with $i_t^2 > i_t^1$. On the indifference map below, qualitatively (and clearly) sketch relevant budget lines and show the consumer's optimal choices of consumption and real money under the two alternative policies. **On the diagram below, note the point on the vertical axis marked "FIXED" – this denotes a point that must lie on ANY budget constraint. Clearly label your diagram, including the slopes of the budget lines.**



Question 2 continued

b. **(5 points)** You are a policy adviser to the central bank, and any advice you give is based only on the goal of maximizing the utility of the representative consumer. The central bank asks you to help it choose between the two nominal interest rates i_t^1 and i_t^2 (and only these two). Which nominal interest rate would you recommend implementing? **Briefly** explain.

c. **(5 points)** Suppose instead the central bank is open to setting any money growth rate, not just either i_t^1 or i_t^2. What would your policy recommendation be? **Briefly** justify your recommendation, **and also in the diagram in part (a) sketch and clearly label a new budget line consistent with your policy recommendation.**

3. **The Fiscal Theory of Exchange Rates (28 points).** In this question, you will use the fiscal theory of exchange rates to analyze some consequences of a fixed exchange rate system. The model is just as we have studied in class – in particular, consumption is constant at $\bar{c} = 11$ in every period, real money demand is described by the function, $M_t / P_t = \phi(\bar{c}, i_t)$, PPP holds, and the foreign price level is equal to one in every period (i.e., $P_t^* = 1$ in every period t). The domestic country runs a fiscal deficit of $DEF = -5.5$ (a **negative** deficit is a **surplus…)** every period, and there is no political will to ever change this deficit. The real money demand function is given by $\phi(\bar{c}, i_t) = \bar{c} - 10 \cdot i_t$, and the exchange rate that the country is pegging (for as long as it can) is $E = 2$ units of domestic currency per unit of foreign currency. Finally, the foreign real interest rate is $r^* = 0.10$, the government starts period 1 with foreign reserves of $B_0^G = 22$, and foreign reserves can never go below zero.

   a. **(3 points)** As long as the fixed exchange rate is in place and is expected to remain in place, what is the numerical value of the domestic nominal interest rate? Briefly justify your answer.

   b. **(3 points)** As long as the fixed exchange rate is in place and is expected to remain in place, what is the numerical value of the domestic country's BOP surplus or BOP deficit? Briefly justify your answer.

   c. **(3 points)** Based on your answer in part b, is the **floating** exchange rate higher than, lower than, or equal to $E = 2$? Briefly justify your answer.

Question 3 continued

d. **(4 points)** If markets/investors for some reason **never expect** a change in the nominal exchange rate, how many periods will the fixed exchange rate last? Briefly justify your answer.

Suppose the government of the domestic country **announces in period T-1 that in period T** the nominal exchange rate will be $E_T = 1.9$, and markets/investors believe this announcement.

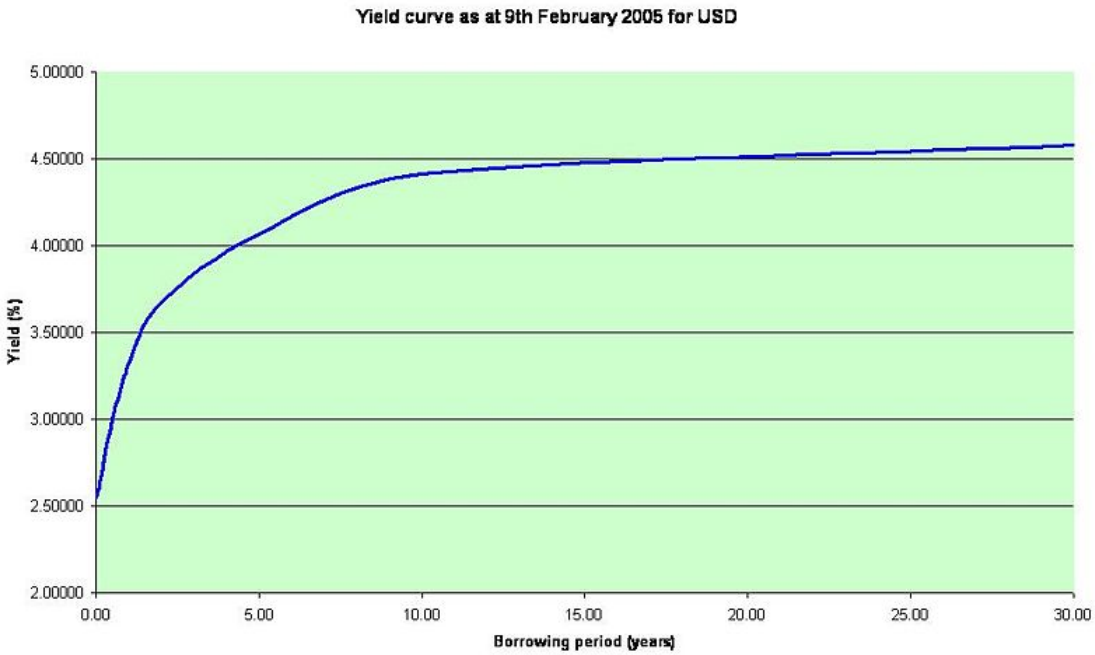
e. **(5 points)** What is the numerical value of the nominal interest rate in period T-1 (i.e., compute i_{T-1})? Briefly justify your answer, and provide economic intuition for what you find, **including a brief economic explanation for why i_{T-1} differs from r^* if it does.**

Question 3 continued

f. **(5 points)** What is the numerical value of seignorage revenue for the domestic government in period T-1? Briefly justify your answer, and provide economic intuition for what you find, **including a brief economic explanation for why seignorage revenue differs from zero if it does.**

g. **(5 points)** How does the domestic country's BOP in period T-1 compare to its BOP in period T-2? Does it rise, fall, or stay the same? **Explain precisely, including why.**

4. The Yield Curve (42 points). An important indicator of markets' beliefs/expectations about the future path of the macroeconomy is the "yield curve," which, simply put, describes the relationship between the maturity length of a particular bond (recall that bonds come in various maturity lengths) and the per-year interest rate on that bond. A bond's "yield" is alternative terminology for its (annual) interest rate. A sample yield curve is shown in the following diagram:



This diagram plots the yield curve for U.S. Treasury bonds that existed in markets on February 9, 2005: as it shows, a 5-year Treasury bond on that date carried an interest rate of about 4 percent, a 10-year Treasury bond on that date carried an interest rate of about 4.4 percent, and a 30-year Treasury bond on that date carried an interest rate of about 4.52 percent.

Recall from our study of bond markets that prices of bonds and nominal interest rates on bonds are negatively related to each other. The yield curve is typically discussed in terms of nominal interest rates (as in the graph above). However, because of the inverse relationship between interest rates on bonds and prices of bonds, the yield curve could equivalently be discussed in terms of the prices of bonds.

In this problem, you will use an enriched version of our infinite-period monetary framework from Chapter 14 to study how the yield curve is determined. Specifically, rather than assuming the representative consumer has only one type of bond (a one-period bond) he can purchase, we will assume the representative consumer has several types of bonds he can purchase – a one-period bond, a two-period bond, and, in the later parts of the problem, a three-period bond.

Let's start just with two-period bonds. We will model the two-period bond in the simplest possible way: in period t, the consumer purchases B_t^{TWO} units of two-period bonds, each of which has a market price $P_t^{b,TWO}$ and a face value of one (i.e., when the two-period bond pays off, it pays back one dollar). **The defining feature of a two-period bond is that it pays back its face value *two* periods after purchase** (indeed, hence the term "two-period bond"…). The one-period bond is just as we have discussed in class and in Chapter 14.

Mathematically, then, suppose (just as in Chapter 14) that the representative consumer has a lifetime utility function starting from period *t*

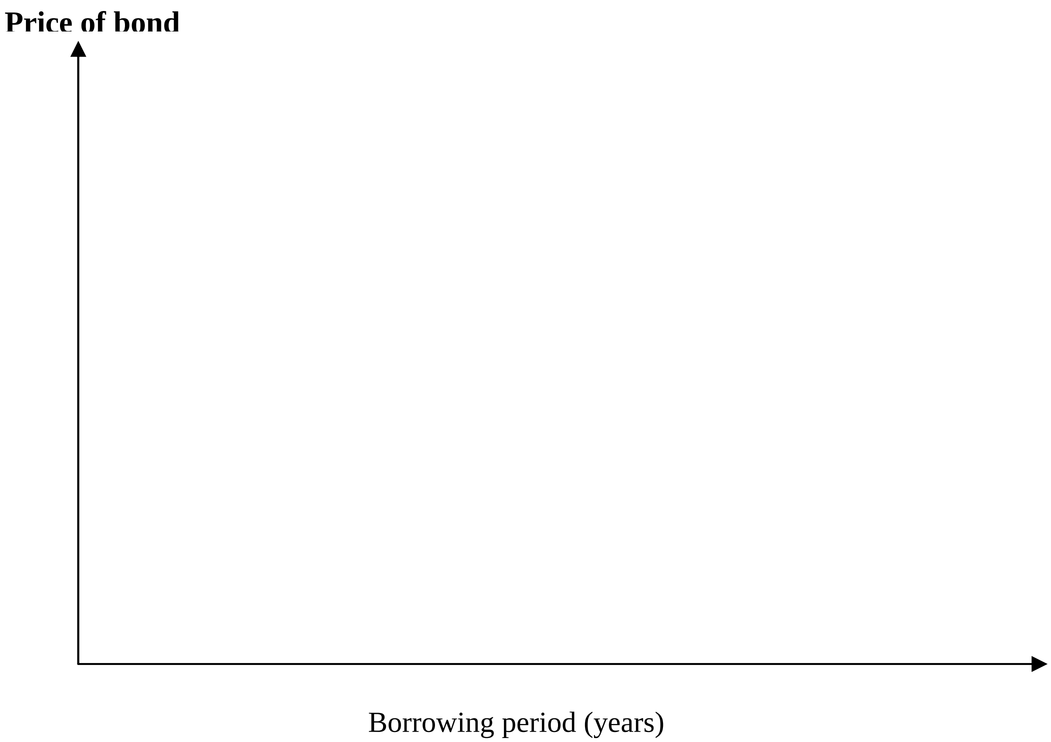
$$\ln c_t + \ln\left(\frac{M_t}{P_t}\right) + \beta \ln c_{t+1} + \beta \ln\left(\frac{M_{t+1}}{P_{t+1}}\right) + \beta^2 \ln c_{t+2} + \beta^2 \ln\left(\frac{M_{t+2}}{P_{t+2}}\right) + \beta^3 \ln c_{t+3} + \beta^3 \ln\left(\frac{M_{t+3}}{P_{t+3}}\right) \ldots,$$

and his period-*t* budget constraint is given by

$$P_t c_t + P_t^b B_t + P_t^{b,TWO} B_t^{TWO} + M_t + S_t a_t = Y_t + M_{t-1} + B_{t-1} + B_{t-2}^{TWO} + (S_t + D_t) a_{t-1}.$$

(Based on this, you should know what the period t+1 and period t+2 and period t+3, etc. budget constraints look like). This budget constraint is identical to that in Chapter 14, except of course for the terms regarding two-period bonds. **Note carefully the timing on the right hand side – in accordance with the defining feature of a two-period bond, in period *t*, it is B_{t-2}^{TWO} that pays back its face value.** The rest of the notation is just as in Chapter 14, including the fact that the subjective discount factor (i.e., the measure of impatience) is $\beta < 1$.

a. **(4 points)** Qualitatively represent (using the axes below) the yield curve shown in the diagram above in terms of **prices of bonds** rather than interest rates on bonds. That is, in the empty set of axes below, plot (qualitatively) on the vertical axis the prices associated with the bonds of various maturity lengths show in the diagram above.



Question 4 continued

b. **(10 points)** Based on the utility function and budget constraint given above, set up an appropriate Lagrangian, and use it to derive the representative consumer's first-order conditions with respect to **both** B_t **and** B_t^{TWO} (as usual, the analysis is being conducted from the perspective of the very beginning of period t). Define any auxiliary notation that you need in order to conduct your analysis.

Question 4 continued

c. **(10 points)** Using the two first-order conditions you obtained in part b, construct a relationship between the price of a two-period bond and the price of a one-period bond. Your final relationship should be of the form $P_t^{b,TWO} = \ldots$, and **on the right-hand-side of this expression should appear** (possibly among other things), P_t^b. (Hint: in order to get P_t^b into this expression, you may have to multiply and/or divide your first-order conditions by appropriately-chosen variables.)

Question 4 continued

d. **(5 points)** Suppose that the optimal **nominal expenditure on consumption** (*Pc*) is equal to 1 in every period (that is, $Pc = 1$ in every period). Using this fact, is the price of a two-period bond greater than, smaller than, or equal to the price of a one-year bond? If it is impossible to tell, explain why; if you can tell, be as precise as you can be about the relationship between the prices of the two bonds. (Hint: you may need to invoke the consumer's first-order condition on consumption)

Question 4 continued

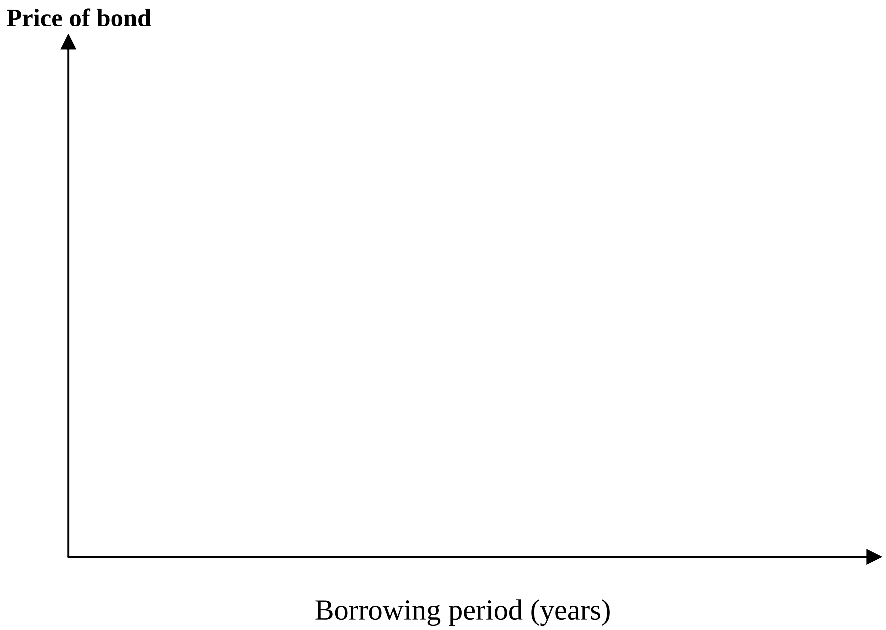
e. **(5 points)** Now suppose there is also a three-period bond. A three-period bond purchased in any given period does not repay its face value (also assumed to be 1) until *three* periods after it is purchased. The period-t budget constraint, now including one-, two-, and three-period bonds, is given by

$$P_t c_t + P_t^b B_t + P_t^{b,TWO} B_t^{TWO} + P_t^{b,THREE} B_t^{THREE} + M_t + S_t a_t = Y_t + M_{t-1} + B_{t-1} + B_{t-2}^{TWO} + B_{t-3}^{THREE} + (S_t + D_t) a_{t-1},$$

where B_t^{THREE} is the quantity of three-period bonds purchased in period t and $P_t^{b,THREE}$ its associated price. Following the same logical steps as in parts b, c, and d above (and continuing to assume that nominal expenditure on consumption (Pc) is equal to one in period every period), is the price of a three-year bond greater than, smaller than, or equal to the price of a two-year bond? If it is impossible to tell, explain why; if you can tell, be as precise as you can be about the relationship between the prices of the two bonds. **(Note: if you can answer this question without setting up a Lagrangian, you may do so.)**

Question 4 continued

f. **(4 points)** Suppose that $\beta = 0.95$. Using your conclusions from parts d and e, **qualitatively** plot a yield curve in terms of bond prices in the set of axes below (obviously, you can plot only three different maturity lengths here).



g. **(4 points)** What is the single most important reason (economically, that is) for the shape of the yield curve you found in part f? (This requires only a brief, qualitative/conceptual response.)

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