Department of Economics University of Maryland

Economics 325

Intermediate Macroeconomic Analysis

Midterm Exam – Part 2

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NAME: ____

Part 2 of the Exam has a total of two (2) problems and pages numbered one (1) through eight (8). 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 one page (double-sided) of notes. You may **not** use a calculator.

Problem 3	**/ 28**
Problem 4	**/ 22**
TOTAL PART 2	**/ 50**

Problem 3: "Hyperbolic Impatience" and Stock Prices (28 points). In this problem you will study a slight extension of the infinite-period economy from Chapter 8. Specifically, suppose the representative consumer has a lifetime utility function given by

$$u(c_t) + \gamma\beta u(c_{t+1}) + \gamma\beta^2 u(c_{t+2}) + \gamma\beta^3 u(c_{t+3}) + \ldots,$$

in which, as usual, $u(.)$ is the consumer's utility function in any period and β is a number between zero and one that measures the "normal" degree of consumer impatience. **The number γ (the Greek letter "gamma," which is the new feature of the analysis here) is also a number between zero and one, and it measures an "additional" degree of consumer impatience, but one that ONLY applies between period t and period t+1.[1] This latter aspect is reflected in the fact that the factor γ is NOT successively raised to higher and higher powers as the summation grows.**

The rest of the framework is exactly as studied in Chapter 8: a_{t-1} is the representative consumer's holdings of stock at the beginning of period *t,* the nominal price of each unit of stock during period *t* is S_t, and the nominal dividend payment (per unit of stock) during period *t* is D_t. Finally, the representative consumer's consumption during period *t* is c_t and the nominal price of consumption during period *t* is P_t. As usual, analogous notation describes all these variables in periods *t*+1, *t*+2, etc.

The Lagrangian for the representative consumer's utility-maximization problem (starting from the perspective of the beginning of period *t*) is

$$\begin{aligned}
&u(c_t) + \gamma\beta u(c_{t+1}) + \gamma\beta^2 u(c_{t+2}) + \gamma\beta^3 u(c_{t+3}) + \ldots \\
&+\lambda_t\left[Y_t + (S_t + D_t)a_{t-1} - P_t c_t - S_t a_t\right] \\
&+\gamma\beta\lambda_{t+1}\left[Y_{t+1} + (S_{t+1} + D_{t+1})a_t - P_{t+1}c_{t+1} - S_{t+1}a_{t+1}\right] \\
&+\gamma\beta^2\lambda_{t+2}\left[Y_{t+2} + (S_{t+2} + D_{t+2})a_{t+1} - P_{t+2}c_{t+2} - S_{t+2}a_{t+2}\right] \\
&+\gamma\beta^3\lambda_{t+3}\left[Y_{t+3} + (S_{t+3} + D_{t+3})a_{t+2} - P_{t+3}c_{t+3} - S_{t+3}a_{t+3}\right] \\
&+\ldots
\end{aligned}$$

NOTE CAREFULLY WHERE THE "ADDITIONAL" IMPATIENCE FACTOR γ APPEARS IN THE LAGRANGIAN.

(OVER)

[1] The idea here, which goes under the name "hyperbolic impatience," is that in the "very short run" (i.e., between period t and period t+1), individuals' degree of impatience may be different from their degree of impatience in the "slightly longer short run" (i.e., between period t+1 and period t+2, say). "Hyperbolic impatience" is a phenomenon that routinely recurs in laboratory experiments in experimental economics and psychology, and has many far-reaching economic, financial, policy, and societal implications.

Problem 3 continued

a. **(4 points)** Compute the first-order conditions of the Lagrangian above with respect to **both** a_t **and** a_{t+1}. (**Note:** There is no need to compute first-order conditions with respect to any other variables.)

b. **(4 points)** Using the first-order conditions you computed in part a, construct two distinct stock-pricing equations, one for the price of stock in period *t*, and one for the price of stock in period *t*+1. Your final expressions should be of the form $S_t = ...$ and $S_{t+1} = ...$ (**Note:** It's fine if your expressions here contain Lagrange multipliers in them.)

Problem 3 continued

For the remainder of this problem, suppose that it is known that $D_{t+1} = D_{t+2}$, and that $S_{t+1}=S_{t+2}$, and that $\lambda_t = \lambda_{t+1} = \lambda_{t+2}$.

c. **(5 points).** Does the above information necessarily imply that the economy is in a steady-state? **Briefly and carefully explain why or why not; your response should make clear what the definition of a "steady state" is.** **(Note:** To address this question, it's possible, though not necessary, that you may need to compute other first-order conditions besides the ones you have already computed above.)

d. **(5 points)** Based on the above information and your stock-price expressions from part b, can you conclude that the period-t stock price (S_t) is higher than S_{t+1}, lower than S_{t+1}, equal to S_{t+1}, or is it impossible to determine? **Briefly and carefully explain the economics (i.e., the economic reasoning, not simply the mathematics) of your finding.**

Problem 3 continued

Now also suppose that the utility function in every period is $u(c) = \ln c$, and also that the **real interest rate is zero in every period.**

e. **(5 points) Based on the utility function given, the fact that $r = 0$, and the basic setup of the problem described above, construct two marginal rates of substitution (MRS):** the MRS between period-t consumption and period-t+1 consumption, **and** the MRS between period-t+1 consumption and period-t+2 consumption.

f. **(5 points – Harder)** Based on the two MRS functions you computed in part e and on the fact that $r = 0$ in every period, determine which of the following two consumption growth rates

$$\frac{c_{t+1}}{c_t} \quad \text{OR} \quad \frac{c_{t+2}}{c_{t+1}}$$

is larger. That is, is the consumption growth rate between period t and period t+1 (the fraction on the left) expected to be larger than, smaller than, or equal to the consumption growth rate between period t+1 and period t+2 (the fraction on the right), or is it impossible to determine? **Carefully explain your logic, and briefly explain the economics (i.e., the economic reasoning, not simply the mathematics) of your finding.**

Problem 4: Government Debt Ceilings (22 points). Just like we extended our two-period analysis of consumer behavior to an infinite number of periods, we can extend our two-period analysis of fiscal policy to an infinite number of periods.

The government's budget constraints (expressed in real terms) for the years 2009 and 2010 are

$$g_{2009} + b_{2009} = t_{2009} + (1+r)b_{2008}$$
$$g_{2010} + b_{2010} = t_{2010} + (1+r)b_{2009}$$

and analogous conditions describe the government's budget constraints in the years 2011, 2012, 2013, etc. The notation is as in Chapter 7: g denotes real government spending during a given time period, t denotes real tax revenue during a given time period (all taxes are assumed to be lump-sum here), r denotes the real interest rate, and b denotes the government's asset position (b_{2008} is the government's asset position at the end of the year 2008, b_{2009} is the government's asset position at the end of 2009, and so on).

At the end of 2008, the government's asset position was roughly a **debt** of $10 trillion (that is, b_{2008} = -$10 trillion).

The current fiscal policy plans/projections call for: g_{2009} = $4 trillion, t_{2009} = $2 trillion, g_{2010} = $3 trillion, and t_{2010} = $2 trillion.

Finally, given how low interest rates are right now and how low they are projected to remain for the next few years, suppose that the real interest rate is always zero (i.e., $r = 0$ always).

a. **(3 points)** Assuming the projections above prove correct, what will be the numerical value of the federal government's asset position at the end of 2009? Briefly explain/justify.

b. **(3 points)** Assuming the projections above prove correct, what will be the numerical value of the federal government's asset position at the end of 2010? Briefly explain/justify.

Problem 4 continued

Under current federal law, the U.S. government's debt cannot be larger than $12 trillion at any point in time. This limit is known as the "debt ceiling."

c. **(3 points) Based on your answer in part a above,** does the debt ceiling pose a problem for the government's fiscal policy plans during the course of the year 2009? If it poses a problem, briefly describe the problem; if it poses no problem, briefly describe why it poses no problem.

d. **(3 points) Based on your answer in part b above,** does the debt ceiling pose a problem for the government's fiscal policy plans during the course of the year 2010? If it poses a problem, briefly describe the problem; if it poses no problem, briefly describe why it poses no problem.

Suppose that the Obama administration only becomes aware of the $12 trillion debt ceiling at the very end of 2009 – to be precise, suppose the administration only becomes aware of it on December 31, 2009, when all of the year's spending and tax collections have ended. Furthermore, suppose Congress does not alter the debt ceiling at all.

e. **(3 points)** Will the government be **forced** (note the emphasis here) to change t_{2010} compared to the projection of t_{2010} = $2 trillion? If not, explain why not. If so, explain in which direction (up or down)?

Problem 4 continued

While we did not formally study the idea of a "government utility function," in complete analogy with consumer theory, we can imagine that the government has a "utility function" for its own spending.[2] Suppose the government's lifetime utility function, starting from the perspective of the very beginning of the year 2009, can be described by the function $u(g_{2009}, g_{2010}, g_{2011}, g_{2012}, ...)$, and this utility function satisfies all the "usual properties" we have been studying (i.e., it is strictly increasing in each argument, with diminishing marginal utility in each argument).

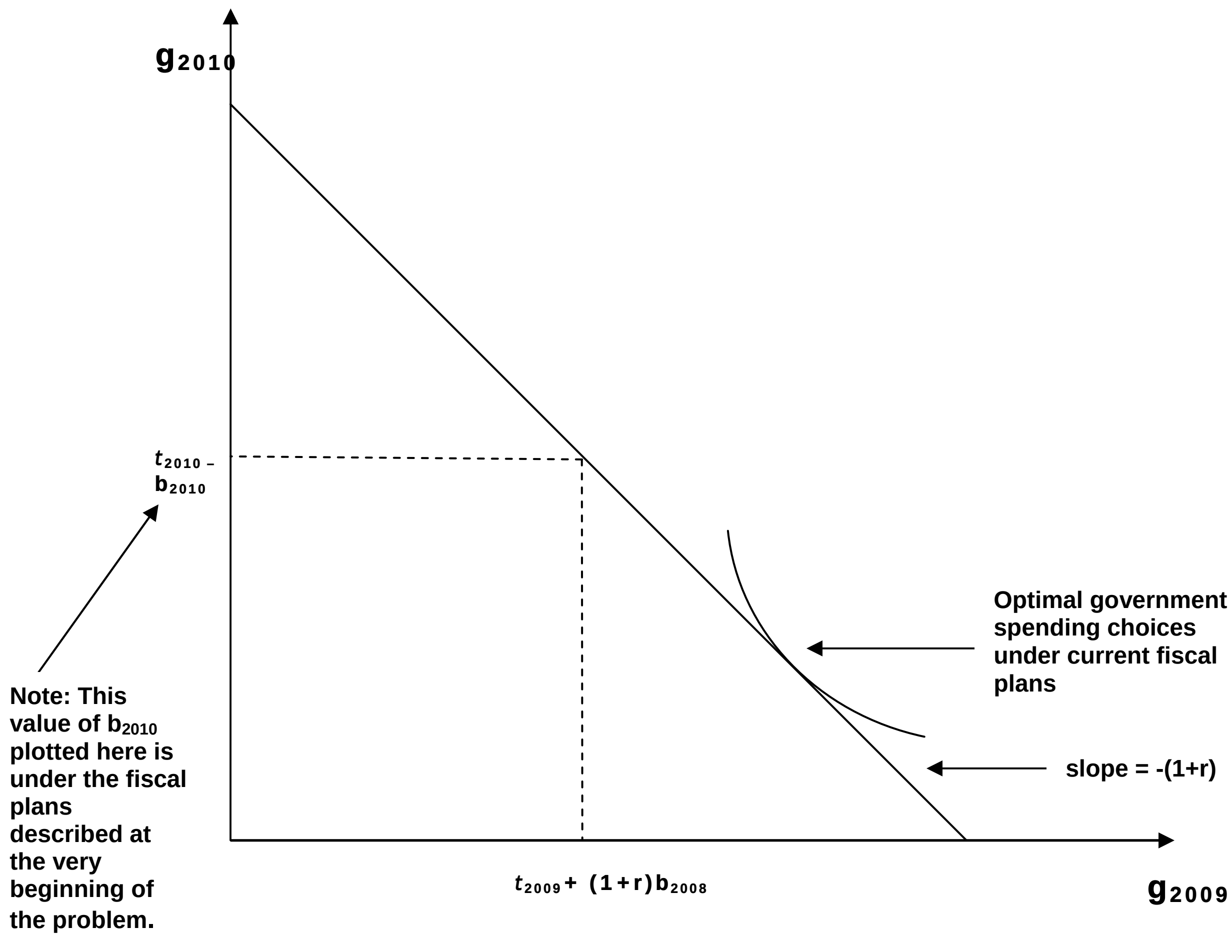
f. **(7 points – Harder)** The following diagram (on the next page) focuses on the two-year time span 2009-2010 and plots the government's budget constraint over the two-year time span along with the government's choices of g_{2009} and g_{2010} as described in parts a and b. The diagram below depicts these choices of g as optimal choices. **Note that this budget line is NOT a LIFETIME budget constraint because the government is NOT assumed to cease operations at the end of 2010.**

Suppose that the debt ceiling law never changes. **Furthermore, because of political reasons, it sometimes seems much easier to change government spending than to change taxes. Let's make this idea black-and-white by now supposing that taxes can never change.**

Once the Obama administration becomes aware of the debt ceiling on December 31, 2009, **illustrate in the diagram below any and all effects that must happen to comply with the debt ceiling. If there are no effects to illustrate, explain why there are none. If there are effects to illustrate, be clear to illustrate *__all__* of them (it is up to you determine what and how many effects there are), and briefly explain your illustration. (Note:** examples of effects to illustrate may be things such as "the budget line pivots outward," etc.)

[2] Ideally, the government's utility function is "benevolent" in the sense that it "should" reflect the needs and desires of its citizens, but corruption etc. can sometimes distort government utility functions. But let's leave aside such issues here and think of the government as "benevolent."

Problem 4g continued



END OF PART 2 OF EXAM