Department of Applied Economics Johns Hopkins University

Economics 602
Macroeconomic Theory
Midterm Exam
Professor Sanjay Chugh
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NAME: ____

The Exam has a total of five (5) problems and pages numbered one (1) through fourteen (14). 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 1	**/ 20**
Problem 2	**/ 33**
Problem 3	**/ 22**
Problem 4	**/ 13**
Problem 5	**/ 12**
TOTAL	**/ 100**

Problem 1: Steady State Analysis (20 points). Suppose that in the infinite-period consumer economy (with no government and hence no taxes at all), a steady state is achieved. Suppose that the beginning of planning horizon assets equals zero, the real interest rate is $r > 0$, the impatience factor is $\beta \in (0,1)$, and the asset that is being studied is something very general, that has (gross) interest rate $1+r$.

a. **(4 points)** In the steady state, the rate of consumption growth between two adjacent periods is defined as $\frac{c_{t+1}}{c_t} - 1$ (completely analogous to how we have defined, say, the rate of growth of prices between period 1 and period 2). **In the steady state, briefly** describe/discuss **(two sentences maximum – rambling essays will not be rewarded)** whether the real interest rate is **positively related to, negatively related to, or not at all related to the rate of consumption growth between period t and period t+1.**

b. **(4 points)** Define qualitatively an economic steady state, distinguishing between how nominal variables behave and how real variables behave. **And (a related question),** in the economic steady state, what conclusions can we draw about the steady state relationship between something about β and something about r? **Be as precise as you can be, but make your response no longer than three sentences.**

Problem 1b continued (if you need more space)

Regardless of what you found above, from here onwards suppose that $\frac{1}{\beta} = 1 + r$ **in the steady state.**

c. **(4 points)** Adopting the standard view in the macroeconomics profession that $\beta \in (0,1)$ is the most basic view that economics has of people, provide a **brief** discussion/description **(two sentences maximum)** about how the steady state relationship above came about. In this explanation, you should **not** rely on anything about the banking system, etc; discuss/describe things in terms of primitives.

Problem 1 continued

d. **(4 points)** What if instead $\beta \in (0,1)$ is a type of "shortcut" to capture the idea that, even though people actually have **finite** lives, the model captures it with an infinite-life model. But then, to actually make the people in the **model** "care" about time, there is a $\beta \in (0,1)$ "shortcut" to make the model work. With this "shortcut" view of β, provide a **brief** discussion/description **(two sentences maximum)** about how the steady-state relationship above would be interpreted. In this explanation, you should **not** rely on anything about the banking system, etc; discuss/describe things in terms of primitives.

e. **(4 points)** Of the two explanations in part c and part d about the basics of β (and ignoring the "fact" that macroeconomists typically think of things in terms of part c), which one sounds "better?" Again limit your response to **two sentences maximum, *and* base your answer on the responses you provided above.**

Problem 2: Consumption, Labor, and Unemployment (33 points). In this question, you will take the Chapter 2 model (static consumption-labor) and modify it to see how **search and matching theory** works. There are two basic ideas that underlie search and matching theory: i) it incorporates into basic supply-and-demand analysis the fact that when an individual wants to work (i.e., "supplies labor"), there is a **chance** that employment may not be found; ii) it builds in the idea that "search" takes some effort.

In terms of formal notation, let p^{FIND} be the **probability** that an individual searching for a job finds suitable employment. By the definitions of probabilities, $p^{FIND} \in [0,1]$ (that is, the probability is a number between zero and one). **Hence, the probability of not finding a job is 1-p^{FIND}.** (**Note:** p does **not** denote a "price.")

And let s be the "search cost," measured in real units (that is, in units of consumption goods) that an individual incurs for **each hour that he/she would like to work.** For example, if the individual desires n = 10 hours of work during the week, the total search cost is 10s; if the individual desires n = 20 hours of work during the week, the total search cost is 20s; and so on.[1] The search cost is $s \geq 0$.

In quantitative and policy applications that use this framework, a commonly-used utility function is

$$u(c,l) = \ln c - \frac{\theta}{1+1/\psi}(168-l)^{1+1/\psi},$$

in which ψ and θ (the Greek letters "psi" and "theta," respectively) are **constants** (even though we will not assign any numerical value to them) in the utility function. The consumer has no control over either ψ or θ, and both $\psi > 0$ and $\theta > 0$. **You are to use this utility function throughout the analysis.**

The budget constraint, expressed in **real units** (that is, in units of consumption goods), is

$$c + s \cdot (168-l) = w \cdot (168-l)$$

in which w denotes the **real wage** and s the search cost, both of which are taken as given by the consumer. **Unless told otherwise (as in part f), use the form of the problem given above (and restated below).**

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[1] The way to interpret this is that it is more costly (in a search sense) to find a job the closer it is to a "full time" job because one has to send out more applications, go through more interviews, etc.

Problem 2 continued

The Lagrangian for this problem is

$$\ln c - \frac{\theta}{1+1/\psi}(168-l)^{1+1/\psi} + \lambda\left[w\cdot(168-l) - c - s(168-l)\right]$$

or, written even more compactly,

$$\ln c - \frac{\theta}{1+1/\psi}(168-l)^{1+1/\psi} + \lambda\left[(w-s)\cdot(168-l) - c\right]$$

with the term in square brackets the budget constraint. **Finally, for use below, note that the derivative of** $\frac{\theta}{1+1/\psi}(168-l)^{1+1/\psi}$ **with respect to *l* (leisure) is:** $-\theta\cdot(168-l)^{1/\psi}$ **(note the minus sign).**

a. **(4 points)** Provide a qualitative **(two sentences maximum)** interpretation of the budget constraint above (i.e., refer to the term in square brackets in the Lagrangian).

b. **(5 points)** In a diagram with consumption on the vertical axis and leisure on the horizontal axis, carefully show the value of the horizontal intercept (i.e., on the leisure axis), briefly describing how you determine this. (Note: there is no need for any optimality condition here; you're simply being asked to first think further about the budget constraint.)

Problem 2 continued

c. **(6 points)** Based on the Lagrangian above, compute the first-order conditions with respect to both c and l. **Then,** combine the two first-order conditions to generate the consumption-"leisure" optimality condition. **(Note: your analysis is to be based on the utility function given above.)**

d. **(6 points)** Not many people are finding jobs successfully. Suppose the Obama administration wants to lower s (the search cost) as a way of helping people. **Given the problem literally as written above,** would this help, would this hurt, or can the issue not be analyzed based on the above? **Limit your answer to three sentences.**

Problem 2 continued

e. **(6 points)** Not many people are finding jobs successfully. Suppose the Obama administration wants to raise p^{FIND} (the probability of successfully finding a job) as a way of helping people. **Given the problem literally as written above,** would this help, would this hurt, or can the issue not be analyzed based on the above? **Limit your answer to three sentences.**

f. **(6 points)** If you concluded in part d and/or part e that s and/or p^{FIND} does **not** play a role in the problem as written above, **qualitatively** describe what one would need to do to make it/them work? **Alternatively,** if they both **did** work, why is there nothing further to do?

Problem 3: Two-Period Economy (22 points). Consider a two-period economy (with no government and hence no taxes at all), in which the representative consumer has no control over his income y_1 and y_2. The lifetime utility function of the representative consumer is $u(c_1, c_2) = \ln c_1 + c_2$, where ln(.) stands for the natural logarithm. (Note: that is not a typo – it is **only** c_1 that is inside a ln(.) function, c_2 is **not** inside a ln(.) function).

There is only a single asset the consumer trades; and the consumer begins period one with zero assets.

On the asset that consumers trade, the real interest rate is initially $r > 0$. As a mathematical proposition, this is fine, but think of this r as **very much** larger than zero. In particular, think about the "credit crisis" in the fall of 2008, when certain values of r went to **historically** large values (and some of them are still very large).

For concreteness, let's think of "period 1" as the fall of 2008 – 2013, and "period 2" to be 2014 – the end of time.

a. **(5 points)** Does the lifetime utility function display **diminishing marginal utility in c_1? And,** does it display **diminishing marginal utility in c_2?** Briefly explain, **in no more than three sentences.** (Note the **two** separate questions here.)

Problem 3 continued

b. **(5 points)** The "credit crisis" of the fall of 2008 – 2013 begins, and r shoots way up. From a **marginal utility perspective (note this phrase),** does the optimal choice of c_1 rise or fall? **And, related,** does the individual **care** about this rise or fall **from a pure (i.e., per-unit) marginal utility perspective?** (Note: your analysis is to be conducted from the perspective of the very beginning of period 1.)

c. **(5 points)** The "credit crisis" of the fall of 2008 – 2013 begins, and r shoots way up. From a **marginal utility perspective (note this phrase),** does the optimal choice of c_2 rise or fall? **And, related,** does the individual **care** about this rise or fall **from a pure (i.e., per-unit) marginal utility perspective?** (Note: your analysis is to be conducted from the perspective of the very beginning of period 1.)

Problem 3 continued

d. **(7 points)** The Federal Reserve notices what's happening. Supposing that the Fed can control both real interest rates and nominal interest rates, it dramatically reduces *r*. Does the Fed's actions do anything to offset the impact on the **pure (i.e., per-unit) marginal utility of c_1? And,** does the Fed's actions do anything to offset the impact on the **pure (i.e., per-unit) marginal utility of c_2? Explain** your answers precisely. (Note: your analysis is to be conducted from the perspective of the very beginning of period 1.)

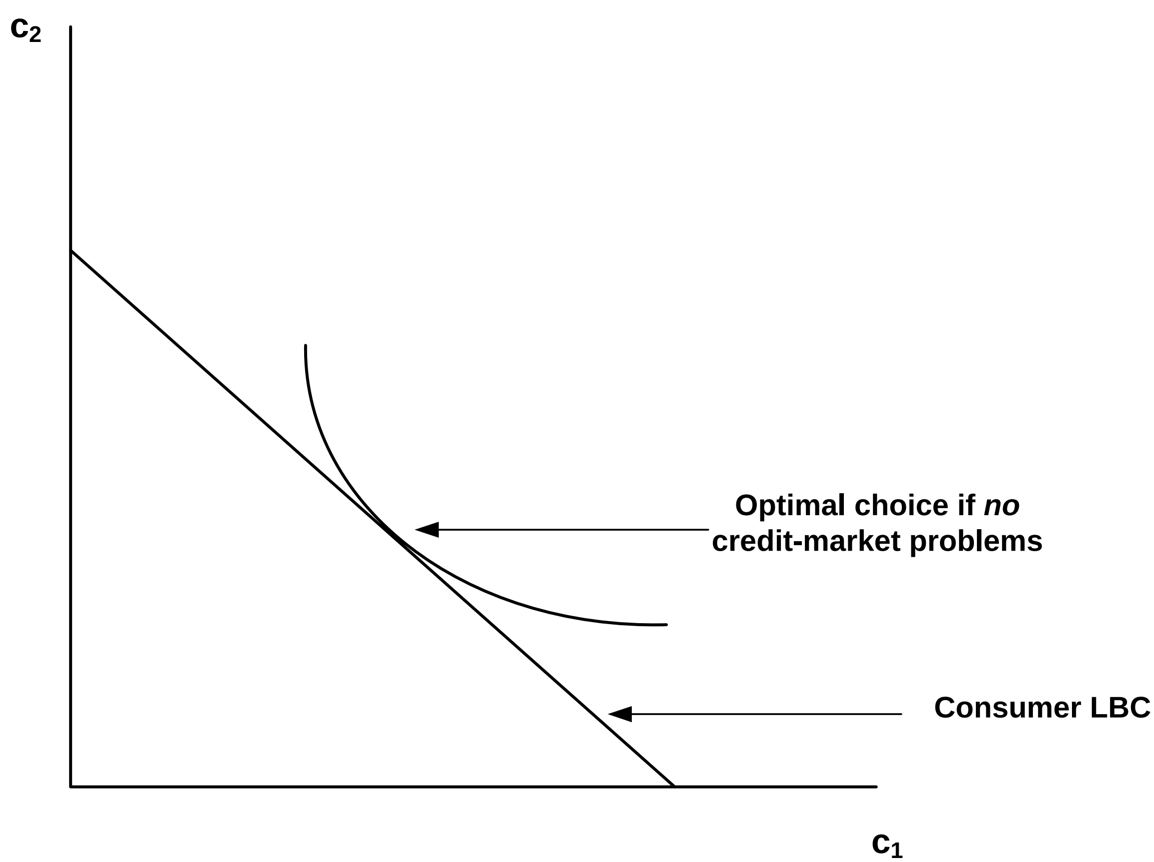
Problem 4: A Contraction in Credit Availability (13 points). The graph below (on the next page) shows our usual two-period indifference-curve/budget constraint diagram, with period-1 consumption plotted on the horizontal axis, period-2 consumption plotted on the vertical axis, and the downward-sloping line representing, as always, the consumer's LBC. Throughout all of the analysis here, assume that ***r* = 0 always.** Furthermore, there is no government, hence never any taxes.

Suppose that the representative consumer has lifetime utility function $u(c_1, c_2) = \ln c_1 + \ln c_2$, and that the **real** income of the consumer in period 1 and period 2 is $y_1 = 12$ and $y_2 = 8$. Finally, suppose that the initial amount of net assets the consumer has is $a_0 = 0$. **EVERY** consumer in the economy is described by this utility function and these values of y_1, y_2, and a_0.

a. **(5 points)** If there are no problems in credit markets whatsoever (so that consumers can borrow or save as much or as little as they want), compute the numerical value of the optimal quantity of period-1 consumption. (**Note:** if you can solve this problem without setting up a Lagrangian, you are free to do so as long as you explain your logic.)

b. **(8 points)** Now suppose that because of problems in the financial sector, no consumers are allowed to be in debt at the end of period 1. With this credit restriction in place, compute the numerical value of the optimal quantity of period-1 consumption. **ALSO,** on the diagram on the next page, qualitatively and **clearly** sketch the optimal choice with this credit restriction in place (qualitatively sketched already for you is the optimal choice if there are no problems in credit markets). Your sketch should indicate **both** the new optimal choice **and** an appropriately-drawn and labeled indifference curve that contains the new optimal choice. (**Note:** if you can solve this problem without setting up a Lagrangian, you are free to do so as long as you explain your logic.)

Problem 4b continued



Problem 5: Government Debt Ceilings (12 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 2011 and 2012 are

$$g_{2011} + b_{2011} = t_{2011} + (1+r)b_{2010}$$
$$g_{2012} + b_{2012} = t_{2012} + (1+r)b_{2011}$$

and analogous conditions describe the government's budget constraints in the years 2013, 2014, 2015, 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_{2010} is the government's asset position at the end of the year 2010, b_{2011} is the government's asset position at the end of 2011, and so on).

Describing numerics qualitatively, at the end of 2010, the government's asset position was roughly a **debt** of $14 trillion (that is, b_{2010} = -$14 trillion).

The current fiscal policy plans/projections call for: g_{2011} = $4 trillion, t_{2011} = $2 trillion, g_{2012} = $3 trillion, and t_{2012} = $2 trillion.

Finally, given how low interest rates are right now and how low they are projected to remain for at least the next couple of 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 2011? Briefly explain/justify **in no more than two sentences.**

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 2012? Briefly explain/justify **in no more than two sentences.**

Problem 5 continued

Under current federal law, the U.S. government’s debt cannot be larger than $16 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 2011? 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 2012? If it poses a problem, briefly describe the problem; if it poses no problem, briefly describe why it poses no problem

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END OF EXAM