Department of Applied Economics Johns Hopkins University

Economics 602
Macroeconomic Theory and Policy
Final Exam
Suggested Solutions
Professor Sanjay Chugh
Fall 2011

NAME: _____

The Exam has a total of four (4) problems and pages numbered one (1) through sixteen (16). 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.**

In particular, some of the questions state explicit WORD COUNT limits – respect these limits.

You are to answer all questions in the spaces provided.

You may use two pages (double-sided) of notes. You may **not** use a calculator or any other aids.

Problem 1	**/ 30**
Problem 2	**/ 30**
Problem 3	**/ 25**
Problem 4	**/ 15**
TOTAL	**/ 100**

Problem 1: The Consumption-Leisure Framework (30 points). In this question, you will use the basic (one period) consumption-leisure framework to consider some labor market issues.

Suppose the representative consumer has the following utility function over consumption and **labor,**

$$u(c,n) = \ln c - An\,,$$

where, as usual, c denotes consumption and n denotes the number of hours of labor the individual chooses to work. The constant $A > 0$ is outside the control of the individual. (As usual, $\ln(\cdot)$ is the natural log function.)

Suppose the budget constraint (expressed in real, rather than in nominal, terms) the individual faces is $c = (1-t)\cdot w \cdot n$, where t is the labor tax rate, w is the **real** hourly wage rate, and n is the number of hours the individual works.

Recall that in one week there are 168 hours, hence $n + l = 168$ must always be true.

a. **(4 points)** Construct the Lagrangian for the consumer's utility maximization problem, defining any new notation you need to include.

Solution: The Lagrangian is

$$\ln c - An + \lambda\left[(1-t)wn - c\right],$$

in which λ is the Lagrange multiplier.

b. **(4 points)** Based on the Lagrangian in part a, compute the representative consumer's first-order conditions with respect to consumption and with respect to labor. Clearly present the important steps and logic of your analysis.

Solution: The first-order conditions on c and n are

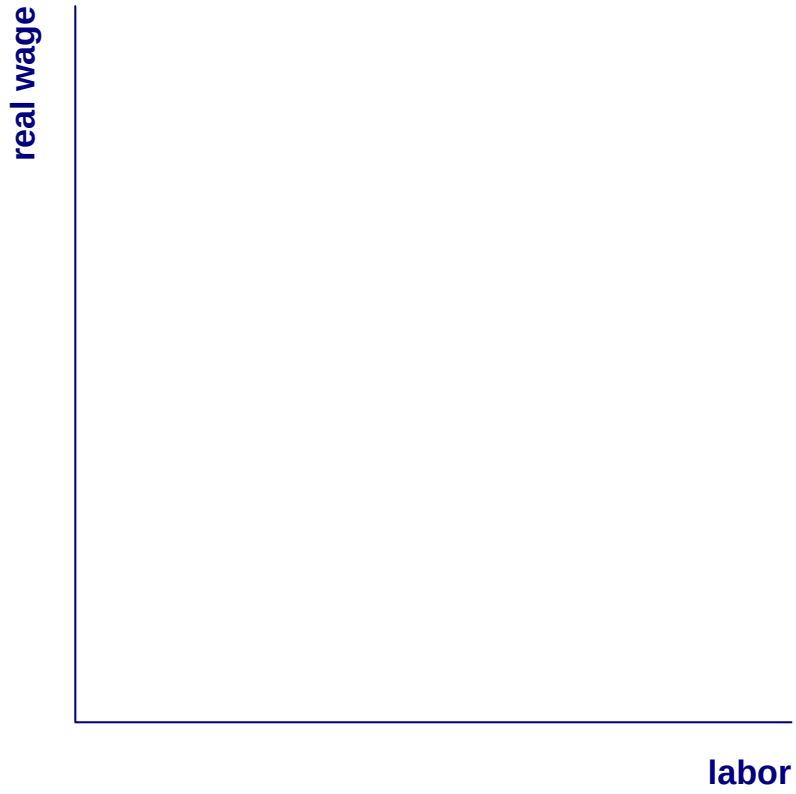
$$\frac{1}{c} - \lambda = 0$$
$$-A + \lambda(1-t)w = 0$$

Problem 1 continued

c. **(6 points)** Based on **ONLY** the first-order condition with respect to labor computed in part b, **qualitatively** sketch two things in the diagram below **and briefly address** one question.

First, sketch the general shape of the relationship between w and n (perfectly vertical, perfectly horizontal, upward-sloping, downward-sloping, or impossible to tell). **Second,** sketch how changes in t affect the relationship (shift it outwards, shift it in inwards, or impossible to determine). **And, briefly (in no more than 10 words!)** describe the **economics** of how you obtained your conclusions. (**IMPORTANT NOTE:** In this question, you are **not** to use the first-order condition with respect to consumption nor any other conditions.)

Solution: Using just the FOC on labor above, there is a **perfectly horizontal** labor supply function that emerges in the diagram below. This is because n simply does not appear in the FOC on labor. Second, because t does appear, it causes the labor supply function to shift up or down. This labor supply function is **perfectly elastic.**



Problem 1 continued

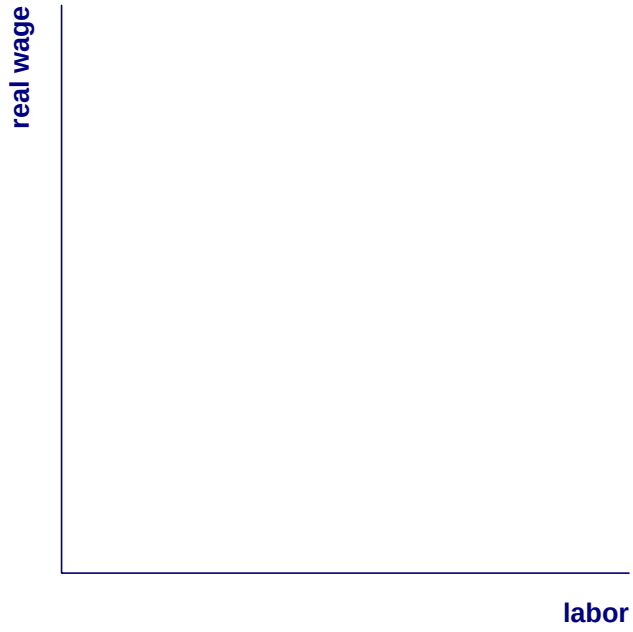
d. **(4 points)** Now based on **both** of the two first-order conditions computed in part b, construct the "consumption-leisure" optimality condition (which technically in this question is the "consumption-labor" optimality condition, but that is a minor detail). Clearly present the important steps and logic of your analysis.

Solution: Proceeding as usual, the FOC on c gives us $\lambda = \frac{1}{c}$, which when inserted in the FOC on labor, gives us $A = \frac{(1-t)w}{c}$. With an algebraic rearrangement (multiplying through by c), we have the consumption-leisure (more properly, the consumption-labor) optimality condition $Ac = (1-t)w$.

e. **(6 points)** Based on both the consumption-leisure optimality condition obtained in part d and on the budget constraint, **qualitatively** sketch two things in the diagram below **and briefly address** one question.

First, sketch the general shape of the relationship between w and n (perfectly vertical, perfectly horizontal, upward-sloping, downward-sloping, or impossible to tell). **Second,** sketch how changes in t affect the relationship (shift it outwards, shift it in inwards, or impossible to determine). **And, briefly (in no more than 10 words!)** describe the **economics** of how you obtained your conclusions.

Solution: From part d above, we have $Ac = (1-t)w$. And the budget constraint is $c = (1-t)wn$. Substituting the latter into the former gives $n = A$ (> 0). The labor supply function is **perfectly vertical (perfectly inelastic)** in this case. A change in taxes does not affect this perfectly inelastic labor supply function.



Problem 1e continued (more work space)

f. **(6 points)** How do the conclusions in part e compare with those in part c? Are they broadly similar? Are they very different? Is it impossible to compare them? **In no more than 80 words,** describe as much as you can about the **economics (not simply restating the mathematics)** when comparing the pair of diagrams.

Solution: Broadly, the difference between part c and part e is that part c is a "microeconomic" analysis, while part e is a "macroeconomic" analysis. More precisely, part c is, intuitively, a purely "slope" argument, rather than both a "slope" and a "level" argument in part e. The analysis in part c is tantamount to analyzing the effects of policy on **just** the labor market (why? – because the analysis there treats consumption as a constant). The analysis in part e instead is tantamount to analyzing **jointly** the effects of policy on labor markets **and** goods markets. To the extent that there are feedback effects between the two markets, there is no reason to think the answers from the analyses must be the same.

The latter is the basis for thinking of the analysis in part c as a "microeconomic" analysis and the analysis in part e as a "macroeconomic" analysis. What this implies is that one way (perhaps the most important way) to understand the difference between "microeconomic" analysis and "macroeconomic" analysis is that the latter routinely considers feedback effects across markets, whereas the former usually does not.

The stark perfectly elastic/perfectly inelastic case first arose in the work of Hansen (1985 *Journal of Monetary Economics*) and Rogerson (1988 *Journal of Monetary Economics*), and has been a staple example, in the sense of being able to easily convey ideas, in macroeconomic analysis since then.

Problem 2: Two-Period Consumption-Savings Analysis with "Risk" (30 points). Consider a variation of the two-period consumption-savings model. The representative consumer begins period one with zero stock holdings ($a_0 = 0$) and zero bond holdings ($B_0 = 0$) (Note: all bonds in this problem are riskless, one-period, face-value = 1 bonds). Also, suppose there is zero inflation in nominal goods prices between period one and period two.

During period one, the consumer can purchase a_1 units of stock, each at the market price of $S_1 > 0$ dollars, and he can also purchase B_1 units of bonds, each at the market price of $P_1^b = 1$ dollars. At the start of period two, each unit of bond will pay off one dollar. Note that there is no risk regarding the bond's nominal payoff in period two, and no risk that the bond's price in period one is anything other than one dollar.

However, there is "risk" regarding stock prices in period two. Specifically, each unit of stock will turn out to have market price of $S_2 > S_1$ dollars in period two, **or** it will turn out to have market price $S_2 = S_1$ in period two. For simplicity, suppose there is zero dividend in period two ($D_2 = 0$) no matter what the price of S_2 turns out to be.

There are no other assets besides stocks and bonds, and suppose that any savings left "under the mattress" will completely disappear (e.g., all resources to be saved have to be put into either stock purchases or bond purchases, or both). Finally, there is no "impatience" discounting between periods.

For your **reference** only, the two consumption-savings optimality conditions (one for stock, and one for bonds) are

$$\frac{u_1(c_1,c_2)}{u_2(c_1,c_2)} = \frac{S_2}{S_1} \quad \text{and} \quad \frac{u_1(c_1,c_2)}{u_2(c_1,c_2)} = \frac{1}{P_1^b}.$$

These are meant to JUST help you think about the problems below, they are NOT necessarily meant to hold exactly in any of the analysis. You should **not** construct any Lagrangians in this problem.

(OVER)

Problem 2 continued

For parts a and b of this problem, suppose the consumer's lifetime utility function **(to which you should pay attention!)** is

$$u(c_1, c_2) = \ln c_1 + \ln c_2$$

a. **(6 points)** Suppose the consumer at the start of period one somehow knows for sure that the stock price will be $S_2 > S_1$ dollars in period two. In this case, solve **qualitatively** for the following, briefly justifying (through a combination of logical and/or mathematical arguments **that should not exceed 20 words each!**) each response. **If you need to make additional reasonable assumptions beyond those provided above, state them clearly as part of the 20 words.**

i) Does the consumer purchase any bonds during period one?

Solution: With $S_2 > S_1$, it makes no sense for the consumer to purchase any bonds. This is because stocks have a strictly positive economic payoff, while bonds have a zero net payoff (due to the fact that the purchase price $P_1^b = 1$ is exactly equal to the payoff of \$1 in period two).

ii) Does the consumer purchase any stock during period one?

Solution: By the same reasoning as above, it makes sense for the consumer to purchase only stocks during period one.

iii) How does the consumer's optimal choices of c_1 and c_2 compare to each other? (i.e., Are they equal to each other? Is one larger than the other? Is it impossible to tell?)

Solution: The MRS = price ratio condition $\left(\frac{u_1(c_1, c_2)}{u_2(c_1, c_2)} = \right) \frac{c_2}{c_1} = \frac{S_2}{S_1} > 1$ shows that the optimal choice of c_2 is larger than the optimal choice of c_1.

Problem 2 continued

b. **(6 points)** Suppose the consumer at the start of period one somehow knows for sure that the stock price will be $S_2 = S_1$ dollars in period two. In this case, solve qualitatively for the following, briefly justifying (through a combination of logical and/or mathematical arguments **that should not exceed 20 words each!**) each response. **If you need to make additional reasonable assumptions beyond those provided above, state them clearly as part of the 20 words.**

i) Does the consumer purchase any bonds during period one?

Solution: With $S_2 = S_1$ and $P_1^b = 1 =$ payoff in period 2, it does not matter if the consumer purchases bonds or not – the return to each type of savings decision is identical (for each \$1 spent on asset purchases in period 1, the consumer receives \$1 back in period 2). So the technically correct answer is "it does not matter."

ii) Does the consumer purchase any stock during period one?

Solution: Exactly as above, with $S_2 = S_1$ and $P_1^b = 1 =$ payoff in period 2, it does not matter if the consumer purchases stock or not – the return to each type of savings decision is identical (for each \$1 spent on asset purchases in period 1, the consumer receives \$1 back in period 2). So the technically correct answer is "it does not matter."

iii) How does the consumer's optimal choices of c_1 and c_2 compare to each other? (i.e., Are they equal to each other? Is one larger than the other? Is it impossible to tell?)

Solution: Based on both the conditions $\left(\frac{u_1(c_1,c_2)}{u_2(c_1,c_2)} = \right)\frac{c_2}{c_1} = \frac{S_2}{S_1} = 1$ and $\left(\frac{u_1(c_1,c_2)}{u_2(c_1,c_2)} = \right)\frac{c_2}{c_1} = \frac{1}{P_1^b} = 1$, the consumer's optimal choices of c_2 and c_1 are identical to each other.

Problem 2 continued

For parts c and d of this problem, suppose the consumer's lifetime utility function **(to which you should pay attention!)** is

$$u(c_1, c_2) = c_1 + c_2 .$$

c. **(6 points)** Suppose the consumer at the start of period one somehow knows for sure that the stock price will be $S_2 > S_1$ dollars in period two. In this case, solve **qualitatively** for the following, briefly justifying (through a combination of logical and/or mathematical arguments **that should not exceed 20 words each!**) each response. **If you need to make additional reasonable assumptions beyond those provided above, state them clearly as part of the 20 words.**

i) Does the consumer purchase any bonds during period one?

Solution: With $S_2 > S_1$, it makes no sense for the consumer to purchase any bonds. This is because stocks have a strictly positive economic payoff, while bonds have a zero net payoff (due to the fact that the purchase price $P_1^b = 1$ is exactly equal to the payoff of \$1 in period two).

ii) Does the consumer purchase any stock during period one?

Solution: By the same reasoning as above, it makes sense for the consumer to purchase only stocks during period one.

iii) How does the consumer's optimal choices of c_1 and c_2 compare to each other? (i.e., Are they equal to each other? Is one larger than the other? Is it impossible to tell?)

Solution: The MRS = price ratio condition $\left(\frac{u_1(c_1, c_2)}{u_2(c_1, c_2)} = \right) \frac{c_2}{c_1} = \frac{S_2}{S_1} > 1$ shows that the optimal choice of c_2 is larger than the optimal choice of c_1.

Problem 2 continued

d. **(6 points)** Suppose the consumer at the start of period one somehow knows for sure that the stock price will be $S_2 = S_1$ dollars in period two. In this case, solve qualitatively for the following, briefly justifying (through a combination of logical and/or mathematical arguments **that should not exceed 20 words each!**) each response. **If you need to make additional reasonable assumptions beyond those provided above, state them clearly as part of the 20 words.**

i) Does the consumer purchase any bonds during period one?

Solution: With $S_2 = S_1$ and $P_1^b = 1 =$ payoff in period 2, it does not matter if the consumer purchases bonds or not – the return to each type of savings decision is identical (for each \$1 spent on asset purchases in period 1, the consumer receives \$1 back in period 2). So the technically correct answer is "it does not matter."

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iii) How does the consumer's optimal choices of c_1 and c_2 compare to each other? (i.e., Are they equal to each other? Is one larger than the other? Is it impossible to tell?)

Solution: Based on both the conditions $\left(\frac{u_1(c_1,c_2)}{u_2(c_1,c_2)} = \right)\frac{c_2}{c_1} = \frac{S_2}{S_1} = 1$ and $\left(\frac{u_1(c_1,c_2)}{u_2(c_1,c_2)} = \right)\frac{c_2}{c_1} = \frac{1}{P_1^b} = 1$, it **seems** that the consumer's optimal choices of c_2 and c_1 are identical to each other. However, this is just one possible solution. Another possible solution is, for example, that $c_1 = 0$ and $c_2 > 0$. Or that $c_1 > 0$ and $c_2 = 0$. Given the **linear** utility function, it simply does not matter how consumption is spread across the two periods.

Problem 2 continued

e. **(6 points)** How do your responses to part b compare to your responses to part d? Are they identical? Do they differ? Is it impossible to tell? Discuss/describe as thoroughly as possible **in terms of economics in no more than 100 words (and do not simply restate the mathematics, unless it clearly brings new insight).**

Solution: The last part of the solution to part d provides the key idea: linear utility means that the consumer is indifferent, in the case of all financial returns being equal to one, between consumption in a given time period versus in another time period. The linear utility function implies **risk neutrality** across the two time periods: the consumer simply does not care about consuming in period one versus in period two. Contrast this with the case in part b, in which there is strict concavity of the utility function, and hence strict convexity of the marginal utility functions, implies that the consumer is **risk averse** and hence is not willing to tolerate zero consumption in either time period. So it is not simply financial market returns that matter, it is also the risk attitude (risk averse, risk neutral, risk loving) of the party considering holding the financial asset that matter for a particular situation.

Problem 3: The Dynamics of Fiscal and Monetary Policy (25 points). The U.S. debt commission recently "failed" in their attempt to cut government spending and/or raise taxes sufficiently in coming years to balance the lifetime government budget. We'll see how these issues play out in the future; but it is interesting to think that just a few years ago, the lifetime government budget was viewed in a potentially different way.

Let's scroll back the calendar to early 2009, at which point large fiscal **stimulus** in the U.S. was just starting to come on line, and would continue to come on line over the next few years. The precise details broadly included **both tax cuts (or potentially delayed tax hikes, which is effectively the same thing) as well as increased government spending in the next few years**.

Specifically, in early 2009, the new administration was just seated. At the beginning of 2009, the lifetime consolidated budget constraint of the government was:

$$\frac{B_{2008}}{P_{2009}} = (t_{2009} - g_{2009}) + \frac{t_{2010} - g_{2010}}{1 + r_{2010}} + \frac{t_{2011} - g_{2011}}{(1 + r_{2010})(1 + r_{2011})} + \frac{t_{2012} - g_{2012}}{(1 + r_{2010})(1 + r_{2011})(1 + r_{2012})} + \ldots$$

Line 1: PDV of fiscal deficits

$$+ sr_{2009} + \frac{sr_{2010}}{1 + r_{2010}} + \frac{sr_{2011}}{(1 + r_{2010})(1 + r_{2011})} + \frac{sr_{2012}}{(1 + r_{2010})(1 + r_{2011})(1 + r_{2012)}} + \ldots$$

Line 2: PDV of seignorage

The notation here is as in Chapter 15: t denotes real lump-sum tax collections, g denotes real government spending, sr denotes real seignorage revenue, r denotes the real interest rate, B denotes nominal (one-period) government bonds, and P denotes the nominal price level of the economy (i.e., the nominal price of one basket of consumption). Subscripts indicate time periods, which we will consider to be calendar years. Note, of course, the ellipsis (…) in each line of the above equation.

As indicated above, the first line of the right-hand side is the present discounted value of all fiscal deficits the government will ever run starting from 2009 onwards, and the second line of the right-hand side is the present-discounted value of all seignorage revenue that will ever result from the monetary policy actions of the Federal Reserve starting from 2009 onwards.

The then-newly-named primary economic advisers to President Obama were Treasury Secretary Timothy Geithner, National Economic Council Chairman Lawrence Summers, and Council of Economic Advisers Chairwoman Christina Romer.

Problem 3 continued

In addressing each of the following issues, no quantitative work is required at all; the following questions all require only conceptual analysis, and it is possible that there is more than one "correct" analysis of each.

Two very important points as you address these issues:

1. **You should adopt an EX-ANTE view of the questions, NOT an EX-POST view. That is, if YOU are sitting in early 2009 considering the following questions, you would NOT know what ACTUALLY happens during 2009-2011.**

2. **EACH ISSUE SHOULD BE ADDRESSED IN NO MORE THAN 50 WORDS!**

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a. **(5 points)** Geithner, because of his background as President of the New York Federal Reserve, implicitly advocated that no matter what fiscal policy actions the new administration takes, they should be designed in such a way as to have no effects on the conduct of monetary policy whatsoever. If this is so, what type of fiscal policy – a Ricardian fiscal policy or a non-Ricardian fiscal policy – did Geithner advocate?

Solution: The policy is Ricardian because it is being conducted in a way to ensure that tax revenues and/or government spending adjust (in a PDV sense) to, by themselves, ensure lifetime government budget balance.

Problem 3 continued

b. **(5 points)** The less even-keeled that he is, Summers' comments sometimes seem to imply that fiscal stimulus measures should **not** take into account any consequences they may have for the conduct of monetary policy. If the combination of tax cuts and government spending that ultimately pan out over the next few years follow Summers' advice, what are likely to be the consequences for the Federal Reserve's monetary policy in future years? **In particular, will the Fed likely have to expand or contract the nominal money supply?**

Solution: By lowering the PDV of fiscal surpluses (i.e., increasing the PDV of fiscal deficits) and given a fixed B/P (if you assumed this, this is fine; if they made some more sophisticated argument (ie, FTPL) as to why B/P may NOT be fixed, then will need to trace through that argument), the PDV of seignorage revenue must rise to balance the lifetime government budget constraint. Increased seignorage requires an increase (at some point) in the nominal money supply.

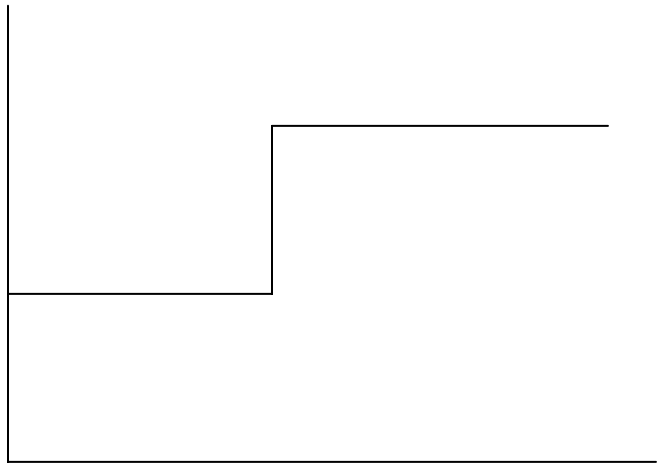
c. **(5 points)** The objective academic macroeconomist that she is, Romer typically points outs in her remarks that because fiscal policy plans (for both taxes and government spending) will almost surely be revised as the years unfold (that is, fiscal policy plans adopted in 2009 can be revised in later years), it may be impossible to know beforehand what the eventual consequences for monetary policy of a particular fiscal policy action adopted at the start of 2009 might be. Use the government budget constraint presented above to interpret what Romer's statements mean.

Solution: The idea of this stylized "statement" is simply that whether or not a given fiscal policy is Ricardian or non-Ricardian in practice is extremely difficult and subjective to assess. For example, if fiscal policy plans are revised fairly often (ie, multiple rounds of stimulus packages, each of which was unforeseen at the time the previous package was passed, etc), what looks like a non-Ricardian policy in one period may look like a Ricardian policy the next year, and so on. Which is a point that we raised in class discussion as well --- this framework provides some parameters for practical policy discussion, but (perhaps moreso than other frameworks we've studied) can be extremely difficult to precisely quantify actual policy actions/consequences.

Problem 3 continued

d. **(5 points)** If, later in 2009 and/or in subsequent years after the new fiscal plans are (supposedly) clarified further, the nominal price level of the economy behaves as shown in the following diagram (the price level, *P,* is plotted on the vertical axis), which of the following is the most relevant explanation: the fiscal theory of the price level, the fiscal theory of inflation, or the financial accelerator mechanism?

Solution: This illustrates the FTPL because there is a one-time jump in P (at the time of the fiscal reform).



e. **(5 points)** Some Federal Reserve officials, including Chairman Ben Bernanke, have recently made statements indicating that Congress must take action to lower the fiscal deficit in the coming years. Even though these are statements by **monetary** policy officials, what type of **fiscal** policy – a Ricardian fiscal policy or a non-Ricardian fiscal policy – are they advocating?

Solution: The most natural interpretation is that the Fed is advocating a Ricardian fiscal policy, in the sense that Congress should (eventually) raise taxes and/or lower government spending to bring the lifetime government budget into balance, without need for monetary policy to monetize the deficit (i.e., by printing money) and/or for market prices to jump (i.e., the FTPL).

Problem 4: The Keynesian-RBC-New Keynesian Evolution (15 points). Here you will briefly analyze aspects of the evolution of macroeconomic theory over the past 25 years. Address each of the following.

a. (5 points) Describe **briefly (in no more than 40 words!)** what the Lucas critique is and how/why it led to the demise of (old) Keynesian models.

Solution: The old Keynesian models were large estimated systems of equations, and the estimated coefficients could not (because they were just based on historical observations) take into account how behavior might change if policy changed. In the 1970's, this led to the downfall of such models as policy-makers tried more and more to exploit these relationships, but the "coefficients" began to vary a lot (for some reason…) with policy, eventually causing the profession (through the Lucas critique) to understand that such models really were not all that useful for policy advice after all.

b. (5 points) In writing down utility functions and production functions for use in "RBC-style" macro models, the assumed functions are typically "estimated" using data (i.e., a common assumption is the logarithmic utility function we have often used, based on some statistical evidence that it is consistent with observed microeconomic and macroeconomic evidence). Is this practice subject to a "Lucas-type critique?" **Briefly (in no more than 40 words!)** explain why or why not?

Solution: Yes, it seems that this practice is also subject to a Lucas-type critique – the parameters/coefficients in the utility and production functions, for example, **could** in principle be dependent on policy. If they are, and policy changes in a particular way that, say, changes consumers' utility functions, then the same pitfalls facing the old Keynesian models arise. To the extent that the development of **any** useful theoretical framework **must** somehow connect with reality (econometric estimation is just one formal way of making that connection), in a very deep sense, one can thus never really "get away from" the Lucas critique.

c. (5 points) Briefly define and describe the neutrality vs. nonneutrality debate surrounding monetary policy. And, as specifically as you can state, which type of shock does this debate concern? **(Your TOTAL response should not exceed 40 words!)**

Solution: The RBC view holds that monetary shocks do not affect real variables (i.e., consumption or GDP) in the economy (neutrality), while the New Keynesian view holds that they do (nonneutrality) because prices take time to adjust (are "sticky").

END OF EXAM