Department of Economics Boston College

Economics 202 (Section 05)

Macroeconomic Theory

Final Exam – Suggested Solutions

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Fall 2013

NAME:

The Final Exam has a total of four (4) problems and pages numbered (following this cover page) **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 should solutions 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 hand-written notes. You may **not** use a calculator.

Problem 1	**/ 20**
Problem 2	**/ 40**
Problem 3	**/ 25**
Problem 4	**/ 15**
TOTAL	**/ 100**

Problem 1: The Consumption-Leisure Framework (20 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.

The Lagrangian is

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

in which λ is the Lagrange multiplier.

a. **(6 points)** Based on the Lagrangian above, 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 with respect to c and n are

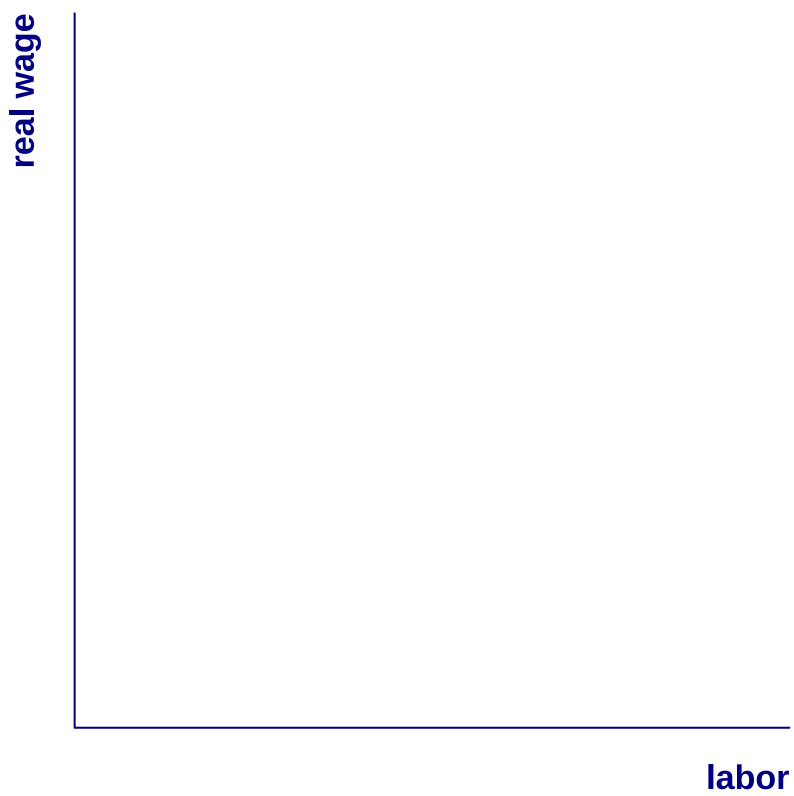
$$\frac{1}{c} - \lambda = 0$$
$$-A + \lambda(1-t)w = 0$$

Problem 1 continued

b. **(4 points)** Based on **ONLY** the first-order condition with respect to labor computed in part a, **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. (**REMINDER: use ONLY the first-order condition with respect to labor.**)

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

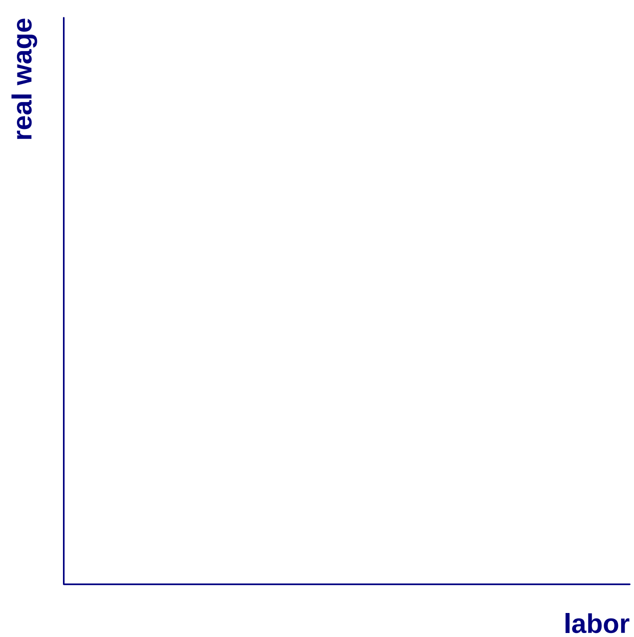
c. **(4 points)** Now based on **both** of the two first-order conditions computed in part a, construct the consumption-leisure optimality condition (which technically in this question is the "consumption-labor" optimality condition, but that is a minor detail). Clearly present the important steps and 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 $Ac = (1-t)w$.

d. **(6 points)** Based on both the "consumption-leisure" optimality condition obtained in part c 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 1d continued (more work space if needed)

Problem 2: Financing Constraints and Housing Markets (40 points). Consider an enriched version of the two-period consumption-savings framework from Chapters 3 and 4, in which the representative individual not only makes decisions about consumption and savings, but also housing purchases. For this particular application, it is useful to interpret "period 1" as the "young period" of the individual's life, and interpret "period 2" as the "old period" of the individual's life.

In the young period of an individual's life, utility depends only on period-1 consumption c_1. In the old period of an individual's life, utility depends both on period-2 consumption c_2, as well as his/her "quantity" of housing (denoted h).[1] From the perspective of the beginning of period 1, the individual's lifetime utility function is

$$\ln c_1 + \ln c_2 + \ln h,$$

in which ln(.) stands for the natural log function; the term $\ln h$ indicates that people directly obtain happiness from their housing.

Due to the "time to build" nature of housing (that is, it takes time to build a housing unit), the representative individual has to incur expenses **in his/her young period** to purchase housing **for his/her old period.** The **real** price in period 1 (i.e., measured in terms of period-1 consumption) of a "unit" of housing (again, think of a unit of housing as square footage) is p_1^H, and the **real** price in period 2 (i.e., measured in terms of period-2 consumption) of a unit of housing is p_2^H.

In addition to housing decisions, the representative individual also makes **stock** purchase decisions. The individual begins period 1 with **zero** stock holdings ($a_0 = 0$), and ends period 2 with **zero** stock holdings ($a_2 = 0$). How many shares of stock the individual ends period 1 with, and hence begins period 2 with, is to be optimally chosen. The **real** price in period 1 (i.e., measured in terms of period-1 consumption) of each share of stock is s_1, and the **real** price in period 2 (i.e., measured in terms of period-2 consumption) of each share of stock is s_2. For simplicity, suppose that stock **never** pays any dividends (that is, dividends = 0 always).

Because housing is a big-ticket item, the representative individual has to accumulate financial assets (stock) while young to overcome the informational asymmetry problem and be able to purchase housing. Suppose the **financing constraint** that governs the purchase of housing is

$$\frac{p_1^H h}{R^H} = s_2 a_1$$

[1] For concreteness, you can think of "quantity" of housing as the square footage and/or the "quality" of the housing space.

(technically an inequality constraint, but we will assume it always holds with strict equality). In the financing constraint, $R^H > 0$ is a government-controlled **"leverage ratio"** for housing. **Note well the subscripts on variables that appear in the financing constraint.**

Finally, the **real** quantities of income in the young period and the old period are y_1 and y_2, over which the individual has no choice.

The **sequential Lagrangian** for the representative individual's problem lifetime utility maximization problem is:

$$\begin{aligned}\text{Lagrangian} = \ln c_1 + \ln c_2 + \ln h + \lambda_1[y_1 - c_1 - s_1 a_1 - p_1^H h] \\ + \lambda_2\left[y_2 + s_2 a_1 + p_2^H h - c_2\right] + \mu\left[s_2 a_1 - \frac{p_1^H h}{R^H}\right],\end{aligned}$$

in which μ is the Lagrange multiplier on the financing constraint, and λ_1 and λ_2 are, respectively, the Lagrange multipliers on the period-1 and period-2 budget constraints.

a. **(5 points) In no more than two brief sentences/phrases,** qualitatively describe what an **informational asymmetry** is, and why it can be a serious problem in financial transactions.

Solution: There are several ways you could have described it, but the core issue is that an informational asymmetry is a situation in which one party to a potential transaction has more knowledge relevant for the transaction than the other party has. In financial markets, this can lead to a lender unwittingly making "too large" of a loan to a borrower, or even "too small" or a loan to a borrower (out of fear of not being fully repaid according to the terms of the loan).

Problem 2 continued

b. **(5 points) In no more than three brief sentences/phrases,** qualitatively describe the role that the leverage ratio R^H plays in the "housing finance" market. In particular, briefly describe/discuss what higher leverage ratios imply for the individual's ability to finance a house purchase (i.e., "obtain a mortgage").

Solution: R^H governs how large of a loan an individual can obtain (and hence how expensive a how the individual can purchase with the loan) for a given amount of "down payment" $s_2 a_1$ (the financial assets the individual pledges for the loan). The higher the leverage ratio, the larger the loan and hence the more expensive a house an individual is able to purchase.

c. **(5 points)** Based on the sequential Lagrangian presented above, compute the **two** first-order conditions: with respect to a_1 and h. (You can safely ignore any other first-order conditions.)

Solution: The two FOCs are:

$$-\lambda_1 s_1 + \lambda_2 s_2 + \mu s_2 = 0$$

$$\frac{1}{h} - \lambda_1 p_1^H + \lambda_2 p_2^H - \frac{\mu p_1^H}{R^H} = 0$$

Problem 2 continued

d. **(5 points)** Based on the first-order condition with respect to h computed in part c, solve for the period-1 real price of housing p_1^H (that is, your final expression should be of the form $p_1^H = ...$ where the term on the right hand side is for you to determine). **(Note: you do NOT have to eliminate Lagrange multipliers from the final expression.)**

Solution: Rearranging the FOC on h computed above, we have, after two steps of algebra,

$$p_1^H = \frac{\frac{1}{h} + \lambda_2 p_2^H}{\lambda_1 + \frac{\mu}{R^H}} = \frac{1 + \lambda_2 p_2^H h}{\mu + \lambda_1 R^H} \cdot \frac{R^H}{h}$$

You did not need to write the expression in the second (far right) form, but it is of course mathematically fine if you did, **HOWEVER,** note that if you did write it this way, you had to recognize in part e that if $\mu = 0$, then R^H **does not appear** in the house price expression.

e. **(5 points)** Based on the expression for p_1^H computed in part d, **and assuming that the Lagrange multiplier μ > 0 (recall, furthermore, that R^H > 0),** answer the following: is the period-1 price of housing **larger than or smaller than** what it would be if financing constraints for housing were **not at all an issue?** Or is it impossible to determine? **Carefully** explain the logic of your argument/analysis, and provide brief economic interpretation of your conclusion.

Solution: If financing constraints do not matter for housing purchases, we would have $\mu = 0$. Relative to an economy in which $\mu = 0$, the **first** expression obtained in part d clearly shows (holding all else constant) that if $\mu > 0$, the price of housing p_1^H **is lower** (and, again, if $\mu = 0$, then the leverage ratio R^H simply does not appear in the house price expression at all). The economic intuition is simply the informational asymmetries that impinge on housing purchases (or, more precisely, the loan/mortgage that must be taken out to finance a housing purchase), which limit the quantity that an individual can borrow and hence limit the size/value of housing purchases an individual can make (relative to an economy in which informational asymmetries are not present or do not have any effect whatsoever, which is the $\mu = 0$ case).

Problem 2 continued

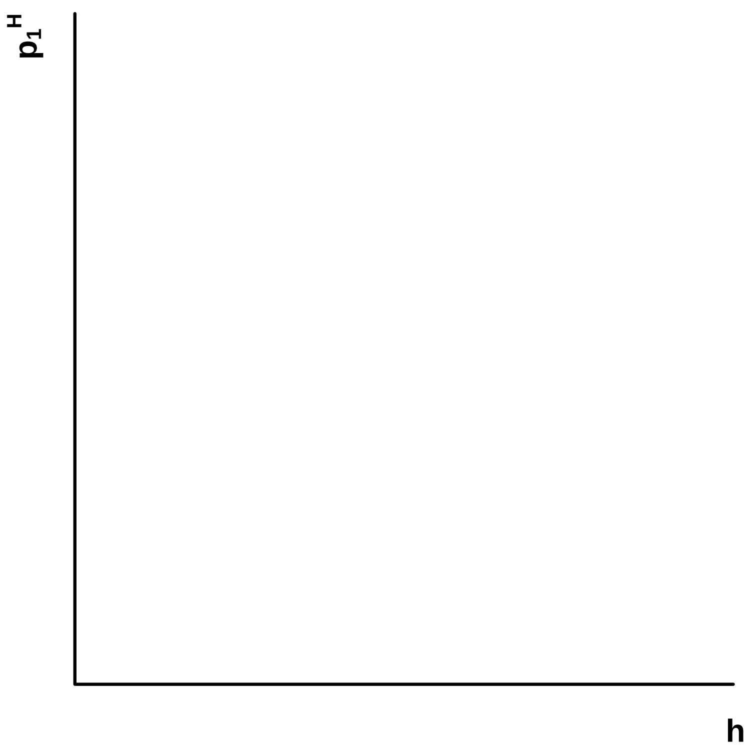
For the remainder of this problem (i.e., for parts f, g, and h), suppose that $\lambda_1 = \lambda_2 = 1$.

f. **(7 points)** Consider the period-1 housing market, as depicted in the diagram below, which shows the quantity *h* of housing drawn on the horizontal axis and the period-1 price, p_1^H, of housing drawn on the vertical axis. Using the house-price expression computed in part d, qualitatively sketch the relationship between *h* and p_1^H that it implies. Your sketch should make clear whether the relationship is upward-sloping, downward-sloping, perfectly horizontal, or perfectly vertical. Clearly present the algebraic/logical steps that lead to your sketch, and clearly label your sketch.

Solution: With $\lambda_1 = \lambda_2 = 0$, the house price expression computed in part d simplifies a bit, to

$$p_1^H = \frac{\frac{1}{h} + p_2^H}{1 + \frac{\mu}{R^H}}.$$

In the space of (p_1^H, h) shown below, simple inspection shows that this defines a downward sloping (and convex, but you did not need to take the analysis this far) relationship. This is the **housing demand function.**



Problem 2 continued

g. **(4 points)** In the **same** sketch in part f, clearly show and label what happens if p_2^H rises. (Examples of what could "happen" are that the relationship you sketched rotates, or shifts, or both rotates and shifts, etc.) Explain the logic behind your conclusion, and provide brief economic interpretation of your conclusion.

Solution: Inspection of the house-price expression in part f clearly shows there is a positive relationship between p_1^H and p_2^H. This is true for any given *h*, hence the entire housing demand function shifts to the right if p_2^H rises. The economics is that, because housing is an asset that has market value (in that respect, exactly like stock), if the price of the asset is going to be higher in the future (period 2), that makes it more attractive to purchase in period 1, hence demand for it rises (shifts).

h. **(4 points)** In the **same** sketch in part f, clearly show and label what happens if R^H rises. (Examples of what could "happen" are that the relationship you sketched rotates, or shifts, or both rotates and shifts, etc.) Explain the logic behind your conclusion, and provide brief economic interpretation of your conclusion.

Solution: Inspection of the house-price expression in part f clearly shows there is a positive relationship between p_1^H and R^H. This is true for any given *h*, hence the entire housing demand function shifts to the right if R^H rises. The economics is that a rise in R^H allows a larger housing purchase (in either house size or price or both) for a given market value of financial assets, $S_2 a_1$. Thus, as the allowed "leverage ratio" for housing rises, demand for it rises (shifts).

Problem 3. The Dynamics of Fiscal and Monetary Policy (25 points). Yet another U.S. "debt ceiling crisis" is approaching, as a joint Congressional committee has so far not made quick progress 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 next couple of months and beyond.

In any case, we are now at the start of 2014, at which point large fiscal **consolidation (the opposite of stimulus)** in the U.S. should be starting to come on line, and would continue to come on line over the next few years. The precise details broadly include **both tax hikes as well as decreased government spending in the near future**.

In early 2014, the lifetime consolidated budget constraint of the government was:

$$\frac{B_{2013}}{P_{2014}} = (t_{2014} - g_{2014}) + \frac{t_{2015} - g_{2015}}{1 + r_{2015}} + \frac{t_{2016} - g_{2016}}{(1 + r_{2015})(1 + r_{2016})} + \frac{t_{2017} - g_{2017}}{(1 + r_{2015})(1 + r_{2016})(1 + r_{2017})} + \dots \quad \textbf{Line 1: PDV of fiscal deficits}$$

$$+ sr_{2014} + \frac{sr_{2015}}{1 + r_{2015}} + \frac{sr_{2016}}{(1 + r_{2015})(1 + r_{2016})} + \frac{sr_{2017}}{(1 + r_{2015})(1 + r_{2016})(1 + r_{2017})} + \dots \quad \textbf{Line 2: PDV of seignorage}$$

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 2014 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 2014 onwards.

The primary economic advisers to President Obama are Treasury Secretary Jacob Lew, incoming (on January 1, 2014) National Economic Council (NEC) Chairman Jeffrey Zients, and soon-to-be-confirmed Federal Reserve Chairwoman Janet Yellen.

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.

a. **(5 points)** Lew advocates that no matter what fiscal policy changes occur in 2014 and beyond, 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 – does Lew 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 soon-to-be NEC Chair Zients has more of a business background than other top economic officials in the U.S. It is not certain yet, but suppose Zients' view turns out to be 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 Zients' 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.

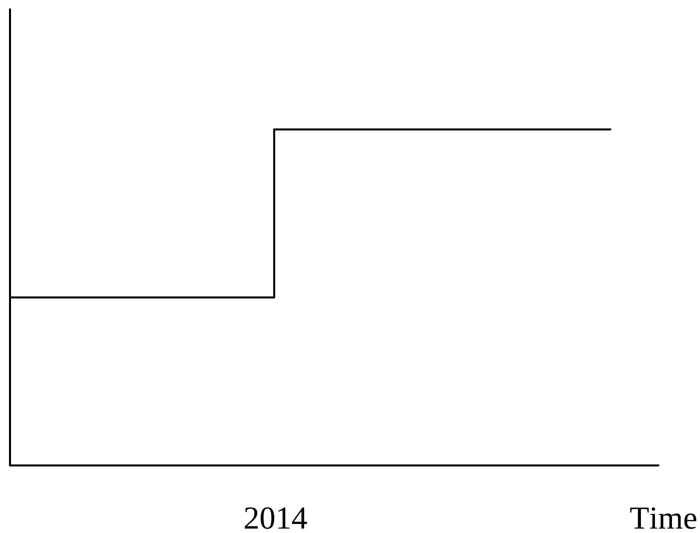
c. **(5 points)** The objective academic macroeconomist that she is, Yellen typically points outs in her remarks that because fiscal policy plans (for both taxes and government spending) will almost surely be revised as the years unfold (that is, fiscal policy plans adopted in 2014 can be revised in 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 2014 might be. Use the government budget constraint presented above to interpret what Yellen'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 2014 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)** Previous Federal Reserve Chairman Alan Greenspan and (soon-to-be previous 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 macroeconometric 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.

Problem 4 continued

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