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Economics 602
Macroeconomic Theory and Policy
Problem Set 8 Suggested Solutions
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1. **Consolidated Government Budget Constraint.** Suppose that at the beginning of period t, $M_{t-1} = 100$ and the government has to repay 10 *nominal* units in government bonds (our usual one-period, FV = 1 bonds). In period t, the fiscal authority (Congress) decides to spend 190 *nominal* units in government spending, collect 180 *nominal* units in taxes, and instructs the Treasury to raise 20 *nominal* units by issuing new (one-period, FV = 1) bonds (that is, the Treasury is ordered to raise 20 nominal units by selling bond, not ordered to sell 20 bonds).
   a. Under this scenario, can the monetary authority decide to expand the money supply (i.e., can it choose $M_t > M_{t-1}$)? Briefly explain why or why not, or, if it is not possible to determine, explain why it cannot be determined.

Solution: Simply use the consolidated period-t GBC,

$$P_t g_t + B_{t-1} = T_t + P_t^b B_t + M_t - M_{t-1}$$

along with the given values: $M_{t-1} = 100$, $B_{t-1} = 10$ (i.e., the bond repayment the government must make in period t), $P_t g_t = 190$ (the nominal spending of the government in period t), $T_t = 180$ (the nominal tax collections of the government in period t), and $P_t^b B_t = 20$ (the amount of nominal revenue the Treasury is instructed to raise on the bond markets for Congress). The only remaining unknown is M_t, which clearly must = 100 in order for the consolidated GBC to be satisfied. Thus, no, the monetary authority cannot expand the money supply because it would violate the consolidated GBC.

   b. Under this scenario, is the monetary authority active or passive? Briefly explain.

Solution: Based on the arguments above, it is clear the monetary authority is passive because it is reacting to the decisions of the fiscal authority. The monetary authority's hands are tied (i.e., it is forced to set $M_t = 100$) by the choices made by the fiscal authority. Thus, if the monetary authority did for some reason want to expand the money supply (to help stimulate GDP in the economy, for example), it cannot.

2. **Unpleasant Monetarist Arithmetic[1].** Consider a **finite** period economy, the final period of which is period T (so that there is no period $T+1$) – every agent in the economy knows that period T is the final period of the economy. In this economy, the government conducts both

[1] This problem is based on a classic work in macroeconomic theory by Thomas Sargent and Neil Wallace ("Some Unpleasant Monetarist Arithmetic," Federal Reserve Bank of Minneapolis *Quarterly Review*, Vol. 5, 1981).

fiscal policy (engaging in government spending and collecting taxes) and monetary policy (expanding or contracting the money supply). **The timing of fiscal policy and monetary policy will be described further below.** The economy has now arrived at the very beginning of period T, and the period-T consolidated government budget constraint is

$$M_T - M_{T-1} + B_T + P_T t_T = (1+i_{T-1})B_{T-1} + P_T g_T,$$

where the notation is as follows:

- M_t is the **nominal** money supply at the end of period t;
- B_t is the **nominal** quantity of government debt outstanding at the end of period t (i.e., a **positive** value of B_t here means that the government is in **debt** at the end of period t);
- t_t is the **real** amount of lump-sum taxes the government collects in period t (and there are no distortionary taxes);
- i_{t-1} is the **nominal** interest rate on government assets held between period $t-1$ and t, and it is **known with certainty in period** $t-1$**;**
- g_t is the **real** amount of government spending in period t;
- P_t is the nominal price level of the economy in period t.

Thus, once period T begins, the economic objects yet to be determined are t_T, g_T, M_T, and B_T. How P_T is set is described more fully below.

a. Compute the numerical value of B_T? Show any important steps in your computations/logic.

Solution: This is simply an application of our idea that an economic agent cannot end its life with anything other than zero assets, because for utility-maximization purposes it would not make sense for it to die with strictly positive assets and if everyone knows the agent will not be around in the next period to pay its debts, it cannot die with strictly negative assets (i.e., cannot die in debt). Hence, we have $B_T = 0$.

The remainder of this question is independent of part a. **For the remainder of this question, suppose that for some reason $B_T = 0$ -- the fiscal authority is committed to this decision about bonds and will never deviate from it**. Also suppose for the remainder of this question that $i_{T-1} = 0.10$, $B_{T-1} = 10$ (i.e., the government is in **debt** at the beginning of period T, given the definition of B_t), $P_{T-1} = 1$ (notice the time subscript here), and $M_{T-1} = 10$.

The timing of fiscal policy and monetary policy is as follows. At the beginning of any period t, the monetary authority and the fiscal authority **independently** decide on monetary policy (the choice of M_t) and fiscal policy (the choices of t_t and g_t), respectively.

Finally, in parts b and c, suppose that the nominal price level is flexible (i.e., it is not at all **"sticky").**

b. Suppose the fiscal side of the government decides to run a **primary real fiscal surplus of** $t_T - g_T = 9$ in period T. Also suppose that the monetary authority chooses a value for M_T which when coupled with this fiscal policy implies that there is **zero inflation** between period $T-1$ and period T. Compute numerically **the real value of seignorage revenue** the government earns in period T, clearly explaining the key steps in your computations/logic. Also provide brief economic intuition for **why** the government needs to generate this amount of seignorage revenue in period T?

Solution: A useful rearrangement of the government budget constraint (GBC) is

$$(1+i_{T-1})B_{T-1} = P_T(t_T - g_T) + M_T - M_{T-1}$$

in which we have imposed $B_T = 0$. A second useful way of writing this expression is

$$(1+i_{T-1})B_{T-1} = P_T\left[t_T - g_T + \frac{M_T - M_{T-1}}{P_T}\right],$$

in which we now have as the second term inside square brackets real seignorage revenue in period T. This expression states that the nominal value of government debt outstanding (inclusive of interest payments) – which is the left-hand-side of this expression – must equal the nominal value of the fiscal surplus plus the nominal value of seignorage revenue.

If there is zero inflation between period $T-1$ and period T, then clearly $P_T = P_{T-1} = 1$. To compute real seignorage revenue, we must first find M_T, the amount of money the monetary authority decides for the end of period T. With the given values, the previous expression immediately gives us that $M_T = 12$. Real seignorage revenue in period T is thus $\frac{M_T - M_{T-1}}{P_T} = \frac{12-10}{1} = 2$.

c. Suppose the monetary authority sticks to its monetary policy (i.e., its choice of M_T) you found in part b above. However, the fiscal authority decides instead to run a primary real fiscal surplus of $t_T - g_T = 8$. Compute numerically **the real value of seignorage revenue** the government must earn in period T **as well as the inflation rate between period $T-1$ and period T.** Clearly explain the key steps in your computations/logic. **In particular,**

why is real seignorage revenue here different or not different from what you computed in part b?

Solution: The monetary authority continues to choose $M_T = 12$, as found in part b above. The GBC of course must continue to hold – let's now use the first form of the GBC derived in part b. Inserting the given values, the GBC becomes $(1+0.10)10 = P_T(8) + 12 - 10$, in which the only unknown is clearly the nominal price level P_T. Thus we have $P_T = 1.125$, which means that there is 12.5 percent inflation between period $T-1$ and period T.

Real seignorage revenue is thus $\frac{M_T - M_{T-1}}{P_T} = \frac{12-10}{1.125} = 1.777$, less than the 2 units of real seignorage revenue in part b. The reason for the difference is that the price level adjusts between period $T-1$ and period T while the monetary authority sticks to a **nominal policy** of $M_T = 12$. The generation of a **smaller real** fiscal surplus in the final period of the economy would mean it needs more real seignorage revenue **if** it had to repay a fixed **real** amount of debt. However, by generating inflation, the government is able to reduce the **real** amount of debt B_{T-1}/P_T it must repay, which offsets the smaller real seignorage revenue.

In part d, assume the nominal price level is "completely sticky" – that is, the nominal price level never varies from one period to the next.

d. With "complete stickiness" of the price level, is a monetary policy that sets the level of M_T you found in part b consistent with a fiscal policy that sets a real fiscal surplus of $t_T - g_T = 8$ as in part c? In other words, can those policies work simultaneously? Explain carefully why or why not, using any appropriate mathematical or logical arguments.

Solution: With complete stickiness, $P_T = P_{T-1} = 1$ because the price level never changes. The GBC then can be written as $(1+i_{T-1})B_{T-1} = t_T - g_T + M_T - M_{T-1}$. Inserting the given values, including that $M_T = 12$ as found in part b, the right-hand-side of this expression is

$$t_T - g_T + M_T - M_{T-1} = 8 + 12 - 10 = 10,$$

while the left-hand-side of this expression is

$$(1+i_{T-1})B_{T-1} = 11.$$

Clearly, then, the GBC doesn't hold with equality! This means this combination of fiscal policy (i.e., $t_T - g_T = 8$) and monetary policy (i.e., $M_T = 12$) doesn't "work" together – they are inconsistent with each other because they do not satisfy the GBC.

e. Reviewing the scenarios posed in parts b, c, and d, address the following question in a brief discussion: what is the role of fiscal policy in determining the inflation rate and/or the nominal price level in the economy? If possible, connect your remarks to the debate between the RBC view and the New Keynesian view. (Note: there is no single correct answer here, but if you conducted the analysis above correctly, there is a generally correct theme that emerges. Also note that you are **not** simply being asked to summarize the results above, but rather to try to draw some bigger-picture insight.)

Solution: Picking up on the theme articulated in the last sentence of the solution in part d: the big picture issue here is that monetary policy and fiscal policy must somehow work "hand-in-hand" with each other. Thus, it is not just monetary policy that determines the path of nominal prices and hence inflation in the economy, but also fiscal policy, a point that is not appreciated enough. With flexible prices (i.e., the RBC view), the way that any arbitrary combination of fiscal policy and monetary policy is "made consistent" with each other is through completely unfettered adjustment of prices – some appropriate amount of inflation can occur through market forces to make the policies work together. However, with (completely) sticky prices, the price-adjustment mechanism is unavailable to make arbitrary combinations of fiscal and monetary policy consistent with each other – in this case, it is incumbent on the fiscal and/or monetary authorities to react to each other's policy choices to make them consistent with each other. Under the New Keynesian view, in which prices are sticky but not **completely** unchangeable, we would obtain an intermediate result – the price-adjustment mechanism works to partially make arbitrary fiscal and monetary policies consistent with each other, but it is also partially incumbent on the policy makers to make them consistent. Note that the ideas developed here, while having nothing to do with our study of exchange rates, are reminiscent of our "fiscal theory of exchange rates" and directly to our look at monetary-fiscal interactions. There, one broad theme that emerged was that fiscal policy and monetary policy somehow had to be "consistent" with each other in order for a fixed exchange rate system to work in the long-run. Here, we see that "consistency" between monetary policy and fiscal policy is a deeper issue throughout macroeconomics, not just exchange rate determination.

3. **The Dynamics of Fiscal Policy.** President Obama and his primary economic advisers have planned to put in place large fiscal stimuli over the next few years. The precise details of the fiscal stimulus are still to be worked out, but they include **both tax cuts as well as increased government spending in the next few years**.

It is early 2009, and the new administration has just recently been seated. At the beginning of 2009, the lifetime consolidated budget constraint of the government is:

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

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 primary economic advisers to President Obama are Treasury Secretary Timothy Geithner, National Economic Council Chairman Lawrence Summers, and Council of Economic Advisers Chairwoman Christina Romer.

(continued)
In addressing each of the following issues, no quantitative work is required at all; the following questions all require only conceptual analysis. Each issue should be addressed in no more than three or four sentences.

a. Geithner, because of his background as President of the New York Federal Reserve, implicitly advocates 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 – does Geithner advocate? **Briefly explain.**

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.

b. The less even-keeled that he is, Summers' comments sometimes seem to imply that the 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 2009 and beyond? **In particular, will the Fed likely have to expand or contract the nominal money supply? Briefly explain.**

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.

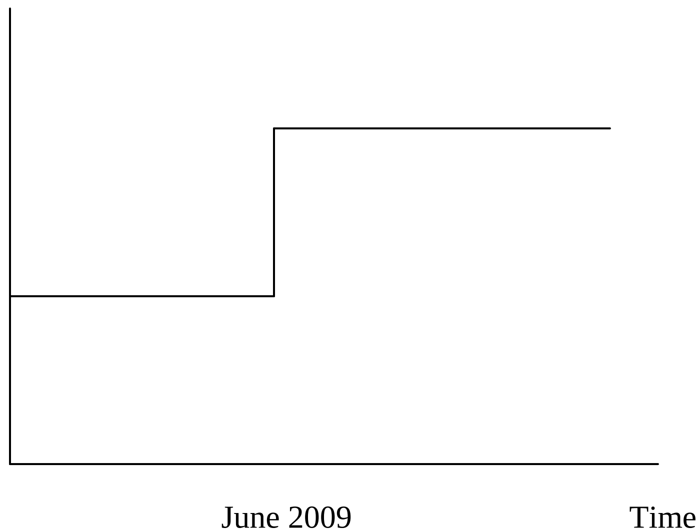
c. The objective academic macroeconomist that she is, Romer typically points outs in her remarks that because fiscal policy plans (for both taxes and government spending) will almost surely be revised as the years unfold (that is, fiscal policy plans adopted in 2009 can be revised in later years), it 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:

d. If, later this year after the new fiscal plans are (supposedly) clarified further, the nominal price level of the economy behaves as shown in the following diagram on the next page (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? **Briefly justify your answer.**

(continued)

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



4. Greece and Long-Run Fiscal (In)Solvency. The current European economic and sovereign debt crisis has put into sharp focus one of the main challenges of enacting a **single** currency zone (the euro zone, or the euro area, as it is officially called) and hence a **single monetary policy** among (17) sovereign countries, but **without** enacting a **single fiscal policy** across those countries. Consider specifically the case of Greece, which is the most highly indebted country (in terms of percentage of its GDP – the Greek government's debt is roughly 150% of Greek GDP) in the euro area. (Throughout the rest of this problem, the terms "single-currency zone," "euro zone," and "euro area" are used interchangeably.)

In this problem, you will apply the Fiscal Theory of the Price Level (FTPL) studied in Chapter 15 to the analysis of fiscal policy in a single-currency zone. In studying or applying the FTPL, the condition around which the analysis revolves is the present-value (lifetime) consolidated government budget constraint (GBC). Recall that, starting from the beginning of period t, the present-value consolidated GBC is

$$\frac{B_{t-1}}{P_t} = \sum_{s=0}^{\infty} \frac{t_{t+s} - g_{t+s}}{\prod_{x=1}^{s}(1+r_{t+x-1})} + \sum_{s=0}^{\infty} \frac{sr_{t+s}}{\prod_{x=1}^{s}(1+r_{t+x-1})},$$

in which all of the notation is just as in Chapter 15.

You are given three numerical values. First, suppose that B_{t-1} = €340 billion (which roughly corresponds to what the Greek government's total nominal debt is at present). Second, assume that $\boldsymbol{t_t - g_t}$ **= – €20 billion (note the minus sign** – this value roughly corresponds to Greece's fiscal balance in the third quarter of 2011). Third, the Greek nominal price level **in period *t*-1 is $\boldsymbol{P_{t-1} = 1}$** (which is a normalization).

Due to its high indebtedness, Greece was under the spectre of default and possible exit from the single-currency zone. To avoid these dramatic adverse consequences, Greece was compelled (by other European governments) to make strict fiscal adjustments as well as other reforms to stabilize the rapid increase in government debt.

Note: in some of the analysis below, you will need to make use of the **geometric summation** result from basic mathematics. A brief description of the geometric summation result: suppose that a variable x is successively raised to higher and higher powers, and the infinite sequence of these terms is summed together, as in

$$\begin{aligned} & x^0 + x^1 + x^2 + x^3 + x^4 + ... \\ & = \sum_{s=0}^{\infty} x^s \end{aligned}$$

(in which the second line compactly expresses the infinite summation using the summation notation Σ). This sum can be computed in a simple way according to

$$\sum_{s=0}^{\infty} x^s = \frac{1}{1-x}.$$

This expression is the geometric summation result (which you studied in a pre-calculus or basic calculus course), which you will need to apply in some of the analysis below.

General Solution: In much of the analysis below, you needed to apply the geometric summation result. This result applies here because all of the economic terms (specifically, $t - g$ and sr) in the present value

GBC do **not** depend on the index of summation *s* and thus can be pulled outside the summation operator. In other words, this is essentially a steady-state analysis. The present value GBC can thus be simplified to

$$B_{t-1} = (t-g)\sum_{s=0}^{\infty}\frac{1}{(1+r)^s} + sr\sum_{s=0}^{\infty}\frac{1}{(1+r)^s},$$

which can be simplified even further. The two key observations you had to make were the following. First, the term $\frac{1}{(1+r)^s}$ can be expressed as $\left(\frac{1}{1+r}\right)^s$ by the rules of exponents. Second, in terms of the general form of the geometric summation given above, the variable "x" corresponds to the term $\frac{1}{1+r}$. Applying the geometric summation result, we have

$$\sum_{s=0}^{\infty}\left(\frac{1}{1+r}\right)^s = \frac{1}{1-\frac{1}{1+r}} = \frac{1}{\frac{1+r-1}{1+r}} = \frac{1}{\frac{r}{1+r}} = \frac{1+r}{r}.$$

With this, the present value GBC is expressed as

$$B_{t-1} = \left(\frac{1+r}{r}\right)(t-g) + \left(\frac{1+r}{r}\right)sr,$$

or, equivalently,

$$B_{t-1} = \left(\frac{1+r}{r}\right)(t-g+sr).$$

The entire analysis is then based on either of these last two representations of the present-value GBC, which from here we will refer to as the PVGBC.

a. In a single-currency zone (such as the euro area), monetary policy is carried out by a "common" central bank (which is the European Central Bank in the euro area). A consequence of this is that individual countries – in particular, Greece – **cannot** print their own money (despite the fact that there **is** a Bank of Greece). What is the implication of this for **Greece's** seignorage revenue? **And,** how would this impact Greece's present-value GBC? Explain as clearly as possible, including, if needed, any mathematical analysis.

Solution: Not being allowed to print nominal money means $M_t - M_{t-1} = 0$ in every period *t*, which in turn means (by definition) that seignorage revenue is $sr_t = \frac{M_t - M_{t-1}}{P_t} = 0$ in every period. Thus, the present-value GBC (PVGBC) is simply

$$\frac{B_{t-1}}{P_t}=\sum_{s=0}^{\infty}\frac{t_{t+s}-g_{t+s}}{\prod_{s=1}^{\infty}(1+r_{t+s})}.$$

The real value of government liabilities thus has to be financed by pure fiscal surpluses.

b. Suppose that Greece commits to stay in the single-currency zone and to carry out all necessary fiscal adjustments to ensure its present-value GBC is satisfied. Suppose that the real interest rate is constant in every period at five percent (r = 0.05) and that the nominal price level in period t will remain P_t = 1 (note this is the period-t price level, not the period t-1 price level).[2] Suppose Greece carries out its fiscal adjustments in period t, **and** (to simplify things a bit) Greece will keep the new fiscal surplus (or fiscal deficit) **constant** at that level in **all** subsequent time periods. **What is the numerical value of the fiscal surplus (or fiscal deficit) in order to ensure that the present-value consolidated GBC from part a is satisfied? That is, what is the numerical value of (t – g)? Be clear about the sign and the numerical magnitude of (t – g).** Present your economic and/or mathematical logic; and provide brief economic explanation.

Solution: Using the given numerical values in the PVGBC,

$$\frac{340\text{ billion}}{1}=\frac{B_{t-1}}{P_t}=\left(\frac{1+0.05}{0.05}\right)(t-g),$$

from which it obviously follows that $(t-g)=16.19\text{ billion}$. Intuitively, if the entire debt has to be repaid using a constant fiscal surplus (and zero seignorage) over time, that surplus has to \$16.19 billion in every time period.

c. Re-do the analysis in part b, assuming instead that r = 0.025. **Compare the conclusion here with the conclusion in part b,** providing brief economic explanation for why the conclusions do or do not differ.

Solution: Using the given numerical values in the PVGBC,

$$\frac{340\text{ billion}}{1}=\frac{B_{t-1}}{P_t}=\left(\frac{1+0.025}{0.025}\right)(t-g),$$

from which it obviously follows that $(t-g)=8.29\text{ billion}$. Intuitively, if the entire debt has to be repaid using a constant fiscal surplus (and zero seignorage) over time, that surplus has to \$8.29 billion in every time period. The required surplus in this case is smaller than in part b because of the lower interest rate, which in turn implies **smaller interest payments on the debt** that has to be repaid.

[2] And note that what is relevant here is the **real** interest rate, **not** the **nominal** interest rate, which had shot up in Greece to about 25% in October 2011. The reason why **real** interest rates, not nominal rates, matter most directly is that markets' expectations of inflation for Greece (if Greece did indeed exit from the euro zone) was near 20%.

d. Under a more realistic view, suppose that Greece still commits to stay in the single-currency zone and to make some, but not all, of the required fiscal adjustments that you computed in part b (perhaps because of "political constraints" that we are leaving outside the analysis). To make it concrete, suppose that Greece is able to run a fiscal surplus of only **€5 billion** in every period (i.e., $t - g$ = €5 in every time period). If the real interest rate is five percent (r = 0.05), compute the **numerical value of P_t** to ensure that the present-value consolidated GBC is satisfied. **Be clear about your logic and computation to arrive at the result;** and provide brief economic explanation.

Solution: Using the given numerical values in the PVGBC,

$$\frac{340\text{ billion}}{P_t} = \frac{B_{t-1}}{P_t} = \left(\frac{1+0.05}{0.05}\right)\cdot 5,$$

which now has to be solved for P_t. Solving this for P_t, we have

$$P_t = \frac{B_{t-1}}{\left(\frac{1+0.05}{0.05}\right)\cdot 5}$$

or P_t = 3.24. Intuitively, if the fiscal surplus cannot be as large as computed in part b and the nominal government debt is fixed at B_{t-1} = 340 (and sr = 0 always), then the only way for the PVGBC to be satisfied is for the price level to adjust (higher) in the short run. This makes the **real** value of the government debt to be **smaller** than B_{t-1} = 340.

e. Re-do the analysis in part d, assuming instead that r = 0.025. **Compare the conclusion here with the conclusion in part d,** providing brief economic explanation for why the conclusions do or do not differ.

Solution: Using the given numerical values in the PVGBC,

$$\frac{340\text{ billion}}{P_t} = \frac{B_{t-1}}{P_t} = \left(\frac{1+0.025}{0.025}\right)\cdot 5,$$

which now has to be solved for P_t. Solving this for P_t, we have

$$P_t = \frac{B_{t-1}}{\left(\frac{1+0.025}{0.025}\right)\cdot 5}$$

or P_t = 1.66. Intuitively, if the fiscal surplus cannot be as large as computed in part c and the nominal government debt is fixed at B_{t-1} = 340 (and sr = 0 always), then the only way for the PVGBC to be satisfied is for the price level to adjust (higher) in the short run. This makes the **real** value of the government debt to be **smaller** than B_{t-1} = 340, but not as small as in the case computed in part d.

f. Assume that Greece decides (against the collective wisdom of other European governments) to **leave** the single-currency zone. Once having left the euro zone, instead of making a serious fiscal adjustment, Greece prefers to cover its debt burden through seignorage revenue, while keeping the fiscal balance **unchanged (in every time period into the future) at $t - g$ = – €20 billion** (note the minus sign). Suppose that the required seignorage revenue is kept at the same level in **all** subsequent years, and assume that r = 0.05 **(which suppose cannot be affected by monetary policy)**. **Address the following three questions:**

   i) How much (per-period) seignorage revenue would Greece need to generate in order to keep its prices at P = 1 in period t and for every period beyond t?

   ii) What are the implications of this particular monetary and fiscal (and, ultimately, political) policy on Greece's own future (i.e., period t and beyond) inflation rate?

   iii) What is the theoretical difference between the analysis in this question and the analysis conducted in parts b and c, **and** with the analysis conducted in parts d and e?

Solution: If the fiscal balance is kept at a **deficit** (of 20 billion), then the per-period seignorage revenue needed to balance the PVGBC **and** keep P = 1 in every period requires computing seignorage revenue from

$$\frac{340 \text{ billion}}{P_t} = \frac{B_{t-1}}{P_t} = \left(\frac{1+0.05}{0.05}\right) \cdot (-20 + sr)$$

(note the -20 on the right-hand side is the per-period fiscal deficit). Solving this for sr gives

$$sr = \left(\frac{0.05}{1+0.05}\right) \frac{B_{t-1}}{P_t} - (t-g),$$

or sr = 36.19 in every period, which answers part i).

If Greece does actually implement and stick with this policy, then inflation will always be zero (i.e., P = 1 for every period into the future), which answers part ii). **BUT** (and this is the key part of the question – although, indeed, this was told to you at the start of the sub-question) Greece is now printing its own currency because it has left the euro currency.

Finally, the analytical difference is simply that we are now allowing for the possibility that seignorage revenue will be generated by Greece due to its creation of its money, which answers part iii).