

Economics 602  
**Macroeconomic Theory and Policy**  
**Problem Set 8 Suggested Solutions**  
 Professor Sanjay Chugh  
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1. **Unpleasant Monetarist Arithmetic**<sup>1</sup>. 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 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  $B_T = 0$ .

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<sup>1</sup> 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).

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.

2. **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:

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

**Line 1: PDV of fiscal deficits**

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

**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 out 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).

