

Economics 325

Intermediate Macroeconomic Analysis
Practice Problem Set 7 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 Arithmetic¹.** 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.