Macro modules 19 and 20: Public debt: practice problems

(The attached PDF file has better formatting.)

This posting gives sample final exam problems. Other topics from the textbook are asked as well; these problems are just examples. All final exam problems are multiple choice; some practice problems are not multiple choice so that the solutions can be better explained.

** Exercise 19.1: Government budget constraint

A budget constraint says that the uses of funds equal the sources of funds.

A. What are the government's uses of funds?
B. What are the government's sources of funds?
C. What is the government's budget constraint?
D. Why does Barro assume the government prints no new money?
E. Why does Barro assume the price level does not change?
F. How does the budget constraint differ for the government vs households?

Part A: A budget constraint says that the use of funds = the source of funds

The government uses funds three ways:

● to buy goods and services from the private sector (*government purchases*)
    ○ building government-owned roads and airports is done by hiring private contractors
    ○ maintaining an army requires paying private persons to be soldiers
● to pay money to private persons without receipt of goods or services
    ○ these *transfers* include social security, welfare, subsidies for student loans
● to *pay interest* to bondholders who lent money to the government in the past
    ○ getting the loan (the principal) from bondholders is a source of funds
    ○ paying semi-annual coupons is a use of funds

Part B: The government has three sources of funds:

● money collected as taxes from the private sector
● money borrowed from the private sector
● money created by its power to print money

See Barro, *Macroeconomics*, Chapter 14, "Public debt," page 256, column 1, Figure 14-1

Part C: The government budget constraint is

purchases + transfers + interest payments = taxes + new debt + revenue from money creation

Barro adds the word "real" to each item in Equation 14.1 on page 256 of Chapter 14. Government spending, transfers, and taxes (G, V, and T) are already in real terms, so no adjustment is used. Government bonds and the money stock are nominal, so they are divided by P.

$$G_t + V_t + i_{t-1} \times (B^g_{t-1} / P_t) = T_t + (B^g_t - B^g_{t-1})/P_t + (M_t - M_{t-1})/P_t$$

Part D: In the United States, the central bank (the Federal Reserve Board) is independent of the government. The government can not print money to reduce its deficit. The FED prints money to reduce fluctuations in the price level and to provide currency when needed for an expanding economy.

Part E: Since the money supply is assumed not to fluctuate much in the United States, the price level also is stable. Assuming variations in the money supply and the price level would complicate the budget constraint without adding to our understanding of government fiscal actions.

The simplified government budget constraint in Barro's textbook is

$$G_t + V_t + r_{t-1} \times (B^g_{t-1} / P) = T_t + (B^g_t - B^g_{t-1})/P$$

The three changes are

- The price level does not change over time, so it has no subscript.
- The money stock does not change over time, so $(M_t - M_{t-1}) = 0$.
- Inflation is zero, so i_{t-1} is replaced by r_{t-1}.

Part F: Four differences are important.

- Households have consumption C; governments have both spending (G) and transfers (V). Consumption and government spending are both part of real GDP; transfers are not part of real GDP.

- Households own capital and they invest in new capital. In Barro's macroeconomic model, the government owns no capital. This is not meant to be realistic, since governments own roads and airports, but it simplifies the model to assume that governments purchase all their goods from private households.

- Households get funds from wage income and returns on capital. Governments get funds from taxes.

- The net value of all private bonds is zero for all households combined. Government bonds are a liability for the government and assets for households. Interest on government bonds is a use of funds for the government and a source of funds for households.

Jacob: Barro says that money is neutral. So why is printing money a source of funds?

Rachel: If the government prints money, the stock of money increases and the price level increases by the same percentage. The nominal supply of money increases, but the real supply of money does not change. The real economy (real variables) remain the same: the goods produced, the labor worked, and real GDP.

Jacob: If the government has more money, isn't the country richer?

Rachel: Wealth comes from real goods, not paper money. Paper money helps value and exchange real wealth. Printing money has no effect on the country's wealth unless it causes people to work more.

Barro gives formulas two ways: algebraic symbols and words. Final exam problems use both versions.

** Exercise 19.2: Real private, government, and national savings

In Barro's equilibrium business cycle model, the government does not own capital, and net government investment is zero. Assume the government issues no new money and the price level does not change from year *t-1* to year *t*.

A. What do households do with their savings?
B. What are real private savings in terms of capital, bonds, and the price level?
C. What does the government do with its savings?
D. Express real government savings in terms of taxes and uses of funds.
E. What are real national savings?

Part A: Households use savings to invest in new capital and to buy bonds.

Part B: New capital is $K_t - K_{t-1}$. Capital K is in real terms, so we don't divide by P to get real savings.

Private bonds have a net value of zero for all households combined. Some macroeconomics textbooks speak of households buying bonds (lending money) and of business firms issuing bonds (borrowing money). Barro uses households to mean both persons and business firms.

Government bonds are issued by the government and bought by households. Net savings from all households combined that are not used to buy new capital are used to buy government bonds. Bonds are expressed in nominal terms, so new government bonds in real terms are $(B^g_t - B^g_{t-1})/P$.

Total private savings in year t are $K_t - K_{t-1} + (B^g_t - B^g_{t-1})/P$.

Part C: The government does not own capital in Barro's model, so its uses its savings to re-purchase its bonds. Bonds are in nominal terms, so its savings are $-(B^g_t - B^g_{t-1})/P$. Note the negative sign: a decrease in government bonds outstanding is positive government savings.

Part D: Real government savings = taxes – government expenditures =

taxes – [government spending + transfers + interest on government debt] =

$$T_t - [(G_t + V_t + r_{t-1} \times (B^g_{t-1} / P))]$$

Take heed: G_t is government spending; $(G_t + V_t + r_{t-1} \times (B^g_{t-1} / P)$ is real *government expenditures*.

Part E: Real national savings ane real private savings plus real government savings, or $K_t - K_{t-1}$.

See Barro, *Macroeconomics*, Chapter 14, "Public debt," pages 256-258.

Jacob: People save money by investing in stocks and bonds. Why don't we include the change in stocks and bonds?

Rachel: For private bonds, the bonds held by households (as assets) equals the bonds issued by firms (as liabilities). For government bonds, the bonds held by households are liabilities of the government.

Stock holdings determine who owns businesses. If one person buys a stock, another person sells it; national wealth does not change.

Jacob: Why do we use $K_t - K_{t-1}$ in this equation instead of $k_t \times K_t - k_{t-1} \times K_{t-1}$? The formulas for the real rate of return on bonds and real GDP use κK, not just K.

Rachel: Real GDP depends on how much capital is used, not just how much is owned. Wealth depends on how much capital is owned, even if some capital is temporarily not used.

Jacob: Are these equations also true if the economy is open?

Rachel: If the economy is open, and foreigners own domestic bonds, an increase in the bonds owned by foreigners is a decrease in real national savings. The chapters on open economies (chapters 17 and 18) are on the web site for this textbook, not in the printed edition; they are not on the VEE course syllabus. The final exam questions also the economy is closed: no foreigners own domestic government bonds.

** Exercise 19.3: Social security

Social security in the United States and most western countries is a pay-as-you-go system.

According to Martin Feldstein's view of social security, people do not adjust their behavior for the effects of government actions on their children or parents.

Answer the following questions according to Feldstein's view of social security.

A. Does the first generation gain or lose from social security? The first generation are workers near retirement when social security began.
B. How does social security affect consumption and savings by the first generation?
C. Do subsequent generations gain or lose from social security?
D. How does social security affect consumption and savings by these subsequent generations?
E. How does social security affect real government savings?
F. How does social security affect real household (private) savings?
G. How does social security affect net investment?
H. How does social security affect the capital stock?
I.   How does social security affect real GDP?

Solution 19.3: Feldstein has the following sequence.

Part A: The first generation receiving social security benefits, who are older persons, do not pay much social security taxes but receive substantial benefits. They have a large positive net benefit of social security (net of taxes paid).

Part B: Consumption by older persons increases by the income effect, since their net wealth increases. Their wage income doesn't change, so their savings decreases.

Part C: The present value of net social security benefits (net of taxes paid) for later generations of workers is a small positive or negative amount. These workers pay for the benefits of the previous generation and are supported by taxes on the next generation.

Part D: Consumption and savings by subsequent generations of workers does not change much.

Part E: Government savings does not change, since money is not saved up front to pay for benefits. The social security trust fund sounds like it holds funds for future benefits. In truth, it holds only a small portion of future benefits.

Part F: Total private savings decreases, since the large net positive benefit to older persons exceeds the net negative benefit to younger persons. For given income, if consumption increases, saving decreases.

Part G: Net investment decreases: net investment equals net savings, and net investment plus consumption equals net disposable income.

Part H: Lower investment decreases the capital stock.

Part I: The reduced capital stock decreases real GDP.

Jacob: Does this mean of government retirement pension systems are not good?

Rachel: Pension system are good if they are fully funded. A funded pension system encourage people to save and increases capital. The Solow growth model says the savings rate affects steady state capital per worker and income per worker. Some people don't save enough on their own, and a government system that forces people to save may help them when they get old.

Jacob: What about the pay-as-you-go government pension systems in the United States and other developed countries (Europe, Japan, Canada)?

Rachel: Many economists think that these pension systems are giant Ponzi schemes. They are not so bad in the population is growing, since the large labor force in subsequent generations pays for the benefits of past generations. But when the population growth rate is negative, as in Japan, western Europe, and the developed countries of south-east Asia, a government pay-as-you-go pension system will eventually collapse. People who have paid social security taxes and not saved in private systems will have no retirement benefits.

Jacob: Does Barro say that Feldstein is correct or incorrect?

Rachel: Barro is not sure. He presents Feldstein's view and he presents also an alternative. He says readers should judge for themselves, though he says that other economists do not find empirical support for Feldstein.

Jacob: Do private pension systems cause a reduction in real national savings?

Rachel: Prefunded pension plans, where workers save and invest money for retirement years, increase real national savings (according to Feldstein's perspective). But in a pay-as-you-go pension system, no money is saved to pay the benefits. Instead, the benefits paid each year are funded by taxes collected that year.

See Barro, *Macroeconomics*, Chapter 14, "Public Debt," page 269

**Exercise 19.4: Social security

Social security in the United States and most western countries is a pay-as-you-go system, whereas private pension plans are fully funded.

A. What is the meaning of pay-as-you-go?
B. Why might this affect real national savings and real GDP?

Part A: In a fully funded plan, each person's retirement benefits are paid from a fund consisting of his/her own contributions plus any contributions from the employer. In a pay-as-you-go system, no fund supports future benefit payments. Instead, the benefits paid to retirees in a given calendar year come from taxes levied on workers in that calendar year.

Part B: People naturally save for retirement. In Barro's equilibrium business cycle model, each person judges expected income over future working years and adjusts consumption and saving each year. A person who expects 40 working years and 20 retirement years may save half of income each year to pay for a pension.

The savings each year are borrowed by businesses to buy capital. Higher savings means more investment, which leads to a higher capital stock and greater real GDP.

In a pay-as-you-go system, people no longer have to save. They can consume all their income, since the retirement benefits of older persons are paid by taxes on younger persons. People consume more and save less. Investment declines, and the capital stock decreases, leading to a lower real GDP.

Jacob: Is this correct? This would imply that advanced western countries in Europe and North America have lower real national savings. But many of these countries have high savings and investment.

Rachel: Barro doesn't know. Many of these countries have low birth rates and high incomes; people with high income and low expenses often save more. He explains Feldstein's hypothesis and says that empirical data do not support it well.

See Barro, *Macroeconomics*, Chapter 14, "Public Debt," page 269

** Exercise 19.5: Open Market Operations

The nominal money supply on January 1, 20X4, is $100 billion and the price level is 100. On January 2, 20X4, the Federal Reserve Board prints $10 billion of new money and buys $10 billion of Treasury bills in the open market. No further open market operations are planned by the FED. What are the effects on

A.   The nominal supply of money?
B.   Real GDP?
C.   The real demand for money?
D.   The real supply of money?
E.   The price level?
F.   The government debt?
G.   The real interest rate?
H.   The expected inflation rate?
I.   The nominal interest rate?

Part A: The nominal supply of money rises to $110 billion.

Part B: Money is neutral. No real variables change, so real GDP does not change.

Part C: The real money supply was $100 billion / 100 = $100 billion on Jan 1, 20X4, so the real demand for money was also $100 billion. Real GDP does not change, so the real demand for money does not change.

Part D: The real money supply is still $100 billion (the real money supply equals the real demand for money).

Part E: The nominal money supply is now $110 billion, so the price level must be 110.

Part F: The government debt declines by $10 billion.

Jacob: The Treasury securities remain outstanding; they are just held by the Federal Reserve Board, not be households.

Rachel: True; the debt is still outstanding, but for the macroeconomics textbook, bonds held by the FED are considered like bonds no longer held by the public.

Part G: The real interest rate depends on the real rental rate and the depreciation rate, which depend on the marginal product of capital and the capital utilization rate. Neither of these change, so the real interest rate does not change.

Part H: The Federal Reserve Board does not intend to continue expanding the stock of money, so the money growth rate does not change and the expected inflation rate does not change.

Part I: The nominal interest rate is the real interest rate plus the expected inflation rate, so it does not change.

Jacob: Nothing happens from open market operations. Why does Barro discuss them?

Rachel: Some economists believe that money is not neutral – that it affects real economic variables. These economists believe that open market operations affect real GDP. The Federal Reserve Board conducts open market operations every month, trying to stabilize the economy or to prevent recessions or to induce growth. Many economists (including Barro) think this hurts the economy by causing fluctuations in the price level; it does not help the economy.