

Problem Set 3 Solutions

October 6, 1995

PROBLEM 1: STOCKS AND FLOWS

a) The difference between stock variables and flow variables are how they are measured. Stock variables measure the amount of the variable at a given moment in time. Flow variables are expressed in units per interval of time. Again, the length of the time interval must be given to measure a flow variable, whereas a stock variable does not have a time dimension. The following examples will hopefully clarify these concepts.

- Consumption is a flow variable. One could tell you what he consumed over the past year, but not how much consumption he had at 5:00 yesterday.
- The amount of bonds is a stock variable. The household has an amount of bonds at a point in time, while the amount of bonds it has for a year or a month does not make sense (only makes sense at points within that time interval).
- Investment is a flow variable. As with consumption, investment is measured through time. A firm makes a certain amount of investment over the last quarter, for example.

To keep from sounding like a broken record, I will only offer explanations only for certain variables.

- Saving: flow. This is the difference between disposable income and consumption, which are both flows.
- National debt: stock.
- GDP deflator: neither. The deflator is an index number, so it does not make sense to measure it in terms of units of the variable.
- Production: flow.
- Trade deficit: flow. The trade deficit is the difference between imports and exports, which must both be measured with respect to an interval of time.
- Car dealer inventories: stock.

- Difference between production and sales: flow. Both production and sales are flow variables.
- Gas in your car: stock.
- Inflation: neither. Remember that inflation is the change in the GDP deflator. Although it is usually specified with respect to an interval of time, it does not measure units of a variable through time since the GDP deflator is an index number.
- Checking account balance: stock.
- Unemployment (i.e., the number of unemployed persons): stock.
- Government budget deficit: flow.

PROBLEM 2: MONEY DEMAND

a) The demand for money depends positively on nominal income. This is because individuals require more money to do more transactions, and nominal income is an approximation for the number of transactions individuals make. The function $L(i)$ is a negative function of the interest rate. Individuals will give up some of the convenience of holding money to get the return on bonds when the interest rate is high. Money demand is related to nominal income rather than real income because the money one requires for transactions is related to the amount one will spend, which depends on current prices, not base year prices. For example, suppose your only transactions are that you buy a cup of coffee every day. If the price of coffee jumps from \$0.90 to \$1.30, you will require more money to complete those transactions even though the quantity of items you buy remains unchanged.

b) Equilibrium in the money market is obtained when money demand equals money supply. Since money supply is fixed at M , the equilibrium condition is given by:

$$M = PY \cdot L(i)$$

Since by assumption there are only two assets with fixed supply of each, equilibrium in the money market implies that the bond market is in equilibrium. The same graph and same equations can be used to describe the bond market equilibrium. The interest rate obtained in the graph of the money market is the rate

that will result in equilibrium in the bond market. [Note: all graphs relevant to the problem set will be reviewed in the Friday recitation.]

c) Because there are only two assets in the economy, the sum of the value of money and bonds must equal the level of wealth: $\$Wealth = M + B$. This equation implies that the supply of bonds is given by $B = \$Wealth - M$, where M is the fixed supply of money. Individuals must allocate their wealth between money and bonds, which means that $\$Wealth = M^d + B^d$. This equation can be rewritten to find the demand for bonds:

$$B^d = \$Wealth - M^d = \$Wealth - \$Y \cdot L(i).$$

Equilibrium in the bond market is given by $B = B^d$, which yields

$$B = \$Wealth - \$Y \cdot L(i),$$

This equilibrium holds if and only if the equilibrium from question 2b holds. To see this, note that the two equations for wealth imply that $M + B = M^d + B^d$, which can be rewritten as $B^d - B = M - M^d$. This last equation says that if money demand equals money supply, then bond demand must equal bond supply, meaning that the bond market is in equilibrium.

d) An increase in $\$Y$ causes the money demand to shift out, as people wish to hold more money for any given interest rate. This results in a rise in the interest rate. Since the money supply has not changed and people now wish to hold more money, bonds must become more attractive to maintain equilibrium. The rise in the interest rate will reduce the amount of money people wish to hold until it again equals the money supply.

If instead the central bank wants to keep the interest rate unchanged, M should be increased. The increase in the demand for money is accommodated by the central bank - it puts an amount of money into the economy equal to the increase in the demand for money at the old interest rate.

e) Money demand is negatively related to $i - i_m$. As the interest rate on bonds rises relative to that on money, people become more willing to give up the convenience of holding money for the higher return on bonds.

When i_m increases, the money demand curve shifts out. For a given level of the interest rate on bonds, people wish to hold more money now that money pays a higher interest rate. Since the supply of money has not changed, to maintain equilibrium the interest rate on bonds must rise to offset the increase in money demand.

PROBLEM 3: MULTIPLE CHOICE

i) c. Since $Y^D = Y - T$, disposable income is zero if and only if taxes equal income. Since income and production are the same, taxes must be equal to GDP.

ii) b. Assuming no role for inventories, production must equal demand in goods market equilibrium. The statement in (a) is true, but this holds by definition, not as an equilibrium condition.

iii) b. In the simplest model we saw that the multiplier exists because when income goes up, people consume more, which in turn raises production and income, so that people consume even more, and so on. Hence an increase in the marginal propensity to save, or a decrease in the marginal propensity to consume, limit the amount consumption rises in each round, which results in a smaller multiplier.

iv) e. A change in government spending causes successively smaller changes in quarterly GDP as the economy approaches its new stable level of production.

v) d. In the equilibrium when output is stable, these are all true.

vi) e.

vii) d. Similar to exercise 2d.

viii) e. Discouraged workers drop out of the labor force, so answers b and c are true. But since $u=U/L$ and $U<L$, subtracting 1 from U and L would decrease u, so a is also true.

ix) c. Professor Blanchard notes that inflation would be a "minor inconvenience" if all prices and wages moved proportionally (p. 21 of Chapter 2).

x) d. The issue of causality here is similar to question 3 on Problem Set 2.

PROBLEM 4: DATA ON INTEREST RATES

a) The interest rate is increasing over the period. This change in the interest rate is consistent with the restriction in the money supply according to our analysis of the money market equilibrium. (Shift the money supply line to the left to see this.)

b) The money market equilibrium is given by $M = \$Y \cdot L(i)$. Dividing both sides by nominal income gives us $\frac{M}{\$Y} = L(i)$. The model predicts that an increase in the interest rate causes a fall in $\frac{M}{\$Y}$, since $L(i)$ is a decreasing function in i . The plot shows a negative correlation between these variables and is therefore consistent with the model. The velocity of money is defined by $\frac{\$Y}{M}$, so another way of saying this is that an increase in the interest rate causes a rise in the velocity of money.

PROBLEM 5: CASH BALANCES

c) Average money holdings are larger under strategy (a). Under strategy (a), the average cash balance over the month is \$50, compared to \$25 for strategy (b). The cost of holding cash is the interest that one foregoes by holding wealth in cash instead of a savings account. This cost is higher in (a) since this strategy involves holding more cash and thus a lower balance in savings. Transactions costs will be higher under strategy (b) since this strategy requires an additional transaction in the middle of the month.

d) The factors to consider are the interest rate on the savings account and the size of the fee for transactions. For example, in considering strategy (b) over strategy (a), one must ask whether the interest received on the additional balance in the savings account outweighs the additional fee of going to the bank halfway through the month. If it does, then (b) is a better strategy than (a). One could then repeat this exercise for different numbers of transactions to find the optimal strategy.