Problem Set #1 Solutions

1. Explain whether or not, why, and how the following items are included in the calculation of GDP:

   a. Increases in business inventories.

   Increases in business inventories are counted in the calculation of GDP so that new goods that are produced but go unsold are still counted in the year in which they are produced. Specifically, they count in *I*.

   b. Fees earned by real estate agents on selling existing homes.

   While the sale of existing homes is not counted in GDP (since the homes weren't produced during the year in question), the service rendered by real estate agents needs to be counted. Thus the fees earned by real estate agents does count in the calculation of GDP, even when the transaction brokered is for an existing home.

   c. Social Security checks written by the government.

   Social Security checks written by the government do not count in GDP, since they do not involve the production of any good or service. More generally, transfers (or transformations) of wealth do not count in the calculation of GDP.

   d. Building of a new dam by the Army Corps of Engineers.

   The goods and services purchased by the government to build the dam will count in the calculation of GDP (in *G*), but the value added over and above the cost of labor and materials is not counted.

   e. An economist earning $2,000 by giving a speech to members of San Francisco's Commonwealth Club.

   An economist earning $2,000 by giving a speech to San Francisco's Commonwealth Club is producing a service, and the fee will be counted in the calculation of GDP (specifically, in *C*).

   f. Interest that your parents pay on the mortgage they have on their house.

   Like all interest paid by households and the government, interest on a homeowner's mortgage is not counted in the calculation of GDP since it is not assumed to flow from the production of goods and services.

   g. Purchases of foreign-made trucks by American residents.

   Purchases of foreign-made trucks by American residents are counted in the calculation of GDP, since the departure of income from the U.S. economy to economies abroad must be accounted for. They enter GDP negatively through the category *IM* and positively through *C*, *I*, or *G* depending on whether households, firms, or government agencies are making the purchase.

   If the magnitude of IM and C, I, or G is the same these will cancel out, which makes sense, since GDP is a measure of domestic production, not foreign production. In reality, C, I, or G may be slightly greater than IM in magnitude, since the final price of the trucks reflects the costs of U.S. distributors and retailers. The net contribution to GDP would be positive due to the production of these services.

h.   Purchase of a remaindered item from inventory by T.J. Maxx from American Apparel.

Remaindered items are bought and sold in a secondary market, and are thus not counted in the calculation of GDP. The items were counted when they entered American Apparel's inventory, and counting them when they are sold to T.J. Maxx would double count them.

i.   12 million Americans watching a commercial on network television.

Though advertisers are paying networks to air commercials on network television, the 12 million Americans watching that commercial aren't paying for any good or service (well, not *yet* anyway). This collective act is thus not counted in the calculation of the GDP.

j.   An economist earning $2,000 by giving a speech about the state of financial markets to the employees of Morgan Stanley.

Morgan Stanley is not a consumer, and training its brokers by having them listen to lectures is not classified as an "investment" that builds its productive capacity (but perhaps it should be). The hope is that listening to the lecture makes Morgan Stanley's stockbrokers better stockbrokers and so their clients will pay them more commissions—and it is those commissions that enter into GDP.

2.   Calculating real magnitudes:

a.   When you calculate real GDP, do you do so by dividing nominal GDP by the price level or by subtracting the price level from nominal GDP?

When calculating real GDP you *divide* the nominal GDP by some measure of the price level.

b.   When you calculate the real interest rate, do you do so by dividing the nominal interest rate by the price level or by subtracting the inflation rate from the nominal interest rate?

When calculating the real interest rate you *subtract* the inflation rate from the nominal interest rate.

c.   Are your answers to the two parts the same? Why or why not?

The answers to these parts differ because calculating the real interest rate involves an approximation that economists use called <u>the growth of a quotient rule</u>, which states that the proportional change of a quotient is (approximately) equal to the difference between the proportional changes of its components. (It isn't precisely, mathematically true, but it's close enough for economists.)

The nominal interest rate is itself a quotient: it represents the ratio of how much money is owed to the original level of principle over some period of time. Similarly, the inflation rate is also a quotient—the ratio of prices at one moment in time to prices at an earlier moment in time. So in calculating the real interest rate—which is the nominal interest rate divided by the interest rate—the growth of a quotient rule tells us that we can save time by simply subtracting the inflation rate from the nominal interest rate.

This rule doesn't apply when calculating real GDP because nominal GDP in a given year and nominal GDP in a base year are not themselves quotients.

3. Suppose that the appliance store buys a refrigerator from the manufacturer on December 15, 2010 for $600, and that you then buy that refrigerator on February 15, 2011 for $1000:

   a. What is the contribution to GDP in 2010?

   The refrigerator represents an increase in inventory for the appliance store. Since the appliance store paid $600 for it the refrigerator will count for $600 in the GDP of 2010.

   b. How is the refrigerator accounted for in the NIPA in 2010?

   The refrigerator represents an increase in inventory for the appliance store in 2010, so the $600 that the refrigerator contributes to GDP in 2010 will be counted in *I*.

   c. What is the contribution to GDP in 2011?

   The contribution to GDP in 2011 is twofold: the final retail price of $1000 and $600 decrease in inventory. Since the decrease in inventory counts negatively, the net contribution to GDP in 2011 is $1,000 - $600 = $400. The $400 added to GDP in 2011 represents the value added by the retailer, whose services included storing, showcasing, and salesmanship.

   d. How is the refrigerator accounted for in the NIPA in 2011?

   The $1000 final retail price is counted in *C* in 2011, while the -$600 change in inventory counts in *I* (that is, it will make I smaller than it otherwise would be in 2011).

4. Is real GDP per worker a good measure of material welfare? Of human well being? Why do you think it is or is not?

   Real GDP per worker serves as an imperfect proxy of material welfare. Wealth, price levels, access to credit, non-market actions (such as household production or subsistence farming) and non-recorded interactions will affect how well a given level of GDP per worker actually reflects material welfare.

   Real GDP per worker is not a very good measure of human well being, since it ignores the effects on human well being that arise from changes in health, leisure, crime, pollution, inequitable distribution, or expectations (to name a few).

5. Suppose a quantity—like real GDP per worker—grows at a steady proportional rate of 2.4% per year. How long will it take to double? Quadruple? Grow 1024-fold?

   By the approximation of "the rule of 72", it will take 72/(2.4) = 30 years for a quantity increasing at an annual rate of 2.4% to double.

   If it takes 30 years for a quantity to double from a baseline year, it will take 60 years to quadruple in size (30 to double, and 30 more to double again).

   1024 = 2^{10}, so for a quantity to grow 1024-fold requires ten doublings. Thus with an annual growth rate of 2.4%, it will take 300 years for a quantity to grow 1024-fold.

   Using "the rule of 70" (the approximation used by Dasgupta), the answers are 70/(2.4) ≈ 29.17 years for a quantity to double, 58.33 years for it to quadruple, and 291.67 years for it to increase 1024-fold.

   The rule of 70 usually gives more accurate answers; 72 is more commonly used as the numerator because its abundance of factors makes it mathematically more convenient.

6. Suppose we have a quantity x that varies with time t, which we write $x(t)$ to indicate that it can be different at different times. Define $dx(t)/dt$ to stand for that quantity's rate of change with time. (Don't blame me: blame Newton and Liebnitz.) If $x(t)$ follows the equation: $dx(t)/dt = -(0.06)x + 0.36$, at what level of x will it be constant—i.e., not changing over time? Call that equilibrium value x^*. If $x(t) > x^*$, is x growing or shrinking over time? If $x(t) < x^*$, is x growing or shrinking over time? Is x^* a stable equilibrium or an unstable equilibrium?

The quantity x will not change over time when its derivative with respect to time is equal to zero; that is, when $dx/dt = -0.06x + 0.36 = 0$. Thus when $x = 6$ it will remain constant and remain unchanged over time. This is called the equilibrium value of x, and we'll label it x^*, so that in this case $x^* = 6$.

If $x(t) > x^*$ then $x(t) > 6$, which means that $dx/dt = -0.06x(t) + 0.36 < 0$. When the derivative of x with respect to time is negative the quantity x will be shrinking over time.

If $x(t) < x^*$ then $x(t) < 6$, which means that $dx/dt = -0.06x(t) + 0.36 > 0$. When the derivative of x with respect to time is positive the quantity x will be growing over time.

In this case $x^* = 6$ is a <u>stable</u> equilibrium, because if through some shock it is perturbed above 6 the quantity of x will shrink until it reaches 6, where it has no tendency to change over time, and if through some shock it is perturbed below 6 it will the quantity of x will grow until it reaches 6, where it again has no tendency to change over time.

7. Solve for the equilibrium level of real GDP Y in the Keynesian framework where: $Y = C + O$, $C = c(o) + c(y)Y$:

a. With $c(o) = \$5$ trillion/year, $c(y) = 1/3$, $O = \$5$ trillion/year

   $Y_{eq} = (c(o) + O)/(1 - c(y)) = (5 + 5)/(1 - 1/3) = 10/(2/3) = 30/2 = 15$, that is, \$15 trillion/year

b. With $c(o) = \$4$ trillion/year, $c(y) = 1/3$, $O = \$5$ trillion/year

   $Y_{eq} = (c(o) + O)/(1 - c(y)) = (4 + 5)/(1 - 1/3) = 9/(2/3) = 27/2 = 13.5$, that is, \$13.5 trillion/year

c. With $c(o) = \$5$ trillion/year, $c(y) = 1/3$, $O = \$4$ trillion/year

   $Y_{eq} = (c(o) + O)/(1 - c(y)) = (5 + 4)/(1 - 1/3) = 9/(2/3) = 27/2 = 13.5$, that is, \$13.5 trillion/year

d. With $c(o) = \$4$ trillion/year, $c(y) = 1/2$, $O = \$4$ trillion/year

   $Y_{eq} = (c(o) + O)/(1 - c(y)) = (4 + 4)/(1 - 1/2) = 8/(1/2) = 16$, that is, \$16 trillion/year

e. With $c(o) = \$4$ trillion/year, $c(y) = 1/2$, $O = \$6$ trillion/year

   $Y_{eq} = (c(o) + O)/(1 - c(y)) = (4 + 6)/(1 - 1/2) = 10/(1/2) = 20$, that is, \$20 trillion/year

8. Solve for the change in the equilibrium level of real GDP in the Keynesian model where $Y = C + O$, $C = c(o) + c(y)Y$:

   a. $c(y) = 4/5$ and the change in O = -\$300 billion/year

      $\Delta Y_{eq} = \Delta O/(1 - c(y)) = -300/(1 - 4/5) = -300/(1/5) = -1500$, that is, -\$1,500 bn/yr or -\$1.5 tr/yr

   b. $c(y) = 3/4$, and the change in O = -\$200 billion/year

      $\Delta Y_{eq} = \Delta O/(1 - c(y)) = -200/(1 - 3/4) = -200/(1/4) = -800$, that is, -\$800 billion/year

   c. $c(y) = 1/3$, and the change in O = +\$50 billion/year

      $\Delta Y_{eq} = \Delta O/(1 - c(y)) = 50/(1 - 1/3) = 50/(2/3) = 150/2 = 75$, that is, \$75 billion/year

   d. $c(y) = 1/2$, and the change in O = +\$500 billion/year

      $\Delta Y_{eq} = \Delta O/(1 - c(y)) = 500/(1 - 1/2) = 500/(1/2) = 1000$, that is, \$1,000 bn/yr or \$1 tr/yr

   e. $c(y) = 2/3$, and the change in O = +\$80 billion/year

      $\Delta Y_{eq} = \Delta O/(1 - c(y)) = 80/(1 - 2/3) = 80/(1/3) = 240$, that is, \$240 billion/year

9. In the monetarist framework where $Y = (M/P)\cdot V$ and V is constant, solve for the equilibrium level of real GDP Y:

   a. If $V = 5$ and $M/P = \$3$ trillion

      $Y_{eq} = (M/P)\cdot V = 3\cdot 5 = 15$, that is, \$15 trillion/year

   b. If $V = 4$ and $M/P = \$6$ trillion

      $Y_{eq} = (M/P)\cdot V = 6\cdot 4 = 24$, that is, \$24 trillion/year

   c. If $V = 10$ and $M/P = \$10$ trillion

      $Y_{eq} = (M/P)\cdot V = 10\cdot 10 = 100$, that is, \$100 trillion/year

   d. If $V = 3$ and $M/P = \$5$ trillion

      $Y_{eq} = (M/P)\cdot V = 5\cdot 3 = 15$, that is, \$15 trillion/year

   e. If $V = 5$ and $M/P = \$4$ trillion

      $Y_{eq} = (M/P)\cdot V = 4\cdot 5 = 20$, that is, \$20 trillion/year

10. In the monetarist framework where $Y = (M/P) \cdot V$ and V is constant, solve for the change in the equilibrium level of real GDP Y:

   a. If $V = 4$ and the change in M/P is -\$1 trillion

   $\Delta Y_{eq} = \Delta[(M/P) \cdot V] = \Delta(M/P) \cdot V = (-1) \cdot 4 = -4$, that is, -\$4 trillion/year

   b. If $V = 6$ and the change in M/P is +\$600 billion

   $\Delta Y_{eq} = \Delta[(M/P) \cdot V] = \Delta(M/P) \cdot V = (600) \cdot 6 = 3600$, that is, \$3,600 bn/yr or \$3.6 tr/yr

   c. If $V = 5$ and the change in M/P is +\$400 billion

   $\Delta Y_{eq} = \Delta[(M/P) \cdot V] = \Delta(M/P) \cdot V = (400) \cdot 5 = 2000$, that is, \$2,000 bn/yr or \$2 tr/yr

   d. If $V = 7$ and the change in M/P is -\$300 billion

   $\Delta Y_{eq} = \Delta[(M/P) \cdot V] = \Delta(M/P) \cdot V = (-300) \cdot 7 = -2100$, that is, -\$2,100 bn/yr or -\$2.1 tr/yr

   e. If $V = 3$ and the change in M/P is -\$100 billion

   $\Delta Y_{eq} = \Delta[(M/P) \cdot V] = \Delta(M/P) \cdot V = (-100) \cdot 3 = -300$, that is, -\$300 billion/year

11. Suppose that the government has decided that it wants to boost the equilibrium level of real GDP Y, and is working within the Keynesian framework and wishes to do so by increasing the level of other spending $O = G + NX + I$:

   a. What is the principal argument for trying to increase O by raising government purchases G?

   It may be the case that due to uncertainty or other factors households, firms, and the foreign sector are unwilling to increase present spending, so that increasing G is the only realistic option.

   Government spending that goes to infrastructure or other factors that might improve productivity may increase future growth throughout the economy.

   b. What is the principal argument for trying to increase O by raising net exports NX?

   This may be politically attractive, since it helps domestic firms and workers at the expense of foreign firms and workers (who, it turns out, don't get to vote in the country's elections).

   c. What is the principal argument for trying to increase O by increasing private investment spending I?

   Increasing I by lowering the interest rate is the easiest and fastest to implement, is the least politicized, and has the least adverse side effects.

   d. What is the principal argument against trying to increase O by raising government purchases G?

   Changing government is slow, it may imply higher interest rates that would crowd out investment spending and reduce net exports, and excessive deficits may erode confidence.

e. What is the principal argument against trying to increase O by raising net exports NX?

Tighter trade restrictions (such as higher tariffs, smaller quotas, or more arduous requirements for imports) will likely be met with reciprocal trade restrictions in foreign markets that will reduce exports, so that in the end *NX* isn't boosted much—if at all.

f. What is the principal argument for against trying to increase O by increasing private investment spending I?

Nominal interest rates cannot be lowered below 0%, and once the interest rate is as low as it can go this ceases to be an effective tool.

Low interest rates may unintentionally inflate an asset bubble in investment spending, such as the overproduction of housing in the middle of this last decade.

12. Suppose that the government has decided that it wants to boost the equilibrium level of real GDP Y, is working within the Keynesian framework, and is deciding whether it will try to do this by increasing the level of other spending O or by increasing $c(o)$:

a. What is the principal argument for preferring to attempt to increase O rather than $c(o)$?

Attempting to increase *O* has more predictable effects.

Raising *c(o)* may be difficult due to credibility problems. ("No, really! This time we *promise* things will get better soon!")

Raising *c(o)* may involve unsustainable levels of private debt.

b. What is the principal argument for preferring to attempt to increase $c(o)$ rather than O?

Attempting to increase *c(o)* is less interventionist and may involve fewer problematic distortions than increasing *O*.

13. How should a government working within the Keynesian framework implement these plans?

a. What policy steps should it take if it wants to boost G?

To boost *G* the government simply needs to borrow and spend more money. It borrows money by selling Treasury bonds to individuals, firms, or foreign governments.

b. What policy steps should it take if it wants to boost NX?

To boost *NX* the government could restrict imports by imposing tariffs, quotas, or other trade barriers.

Also, the government could reduce the interest rate to make the currency less attractive. As investors seek other currencies the domestic currency will weaken, making imports less attractive in the domestic market and making the country's exports more attractive in foreign markets. (Of course, foreign governments may also intervene to manipulate exchange rates.)

c. What policy steps should it take if it wants to boost *I*?

To boost *I* the government should reduce the interest rate, which will make projects with lower rates of return attractive enough to invest in.

Also, measures that instill confidence in the future will help firms decide that it's safe and wise to make investments in the present.

d. What policy steps should it take if it wants to boost *c(o)*?

To boost *c(o)* the government should try to convince households and firms (through rhetoric, data, or legislation) that better times are coming soon, which with luck may become a self-fulfilling prophecy.

Also, the government can make credible commitments to control future deficits (through austerity measures, increased taxes, or other budgetary reforms) if one of the causes of unease is uncertainty regarding the government's future ability to finance its debt.

14. Suppose that a government working in the monetarist framework decides that it wants to boost the equilibrium level of real GDP *Y*. What policy steps should it take?

A government working with a monetarist framework that wants to boost the equilibrium level of real GDP will work to increase the money supply, *M*, by buying bonds or reducing the reserve requirement for banks and financial institutions.

15. The principal monetarist critique of the Keynesian framework is that a government that tries to boost real GDP *Y* by boosting, say, government purchases *G* will find that its attempts to do so produce increases in interest rates that crowd out and reduce *NX* and *I*, the remaining two components of "other" spending.

a. Under what conditions is the monetarist critique likely to be right?

The monetarist critique is likely to be right when there is low demand for bonds (which would imply low prices and high interest rates for bonds). More government spending financed by bonds will further depress the price of bonds and consequently further raise the interest rate, making private investment less attractive. Also, higher interest rates will strengthen the currency, which will boost imports and reduce exports, causing net exports to fall.

b. Under what conditions is the monetarist critique likely to be wrong?

The monetarist critique is likely to be wrong when there is high demand for bonds (which would imply high prices and low interest rates for bonds). More government spending financed by bonds will reduce the price of bonds and consequently raise the interest rate somewhat, but probably not enough to reduce private investment much.

If the interest rate is very low already and firms are not investing much anyway (due to uncertainty, perhaps) then the monetarist critique would also not be very applicable. If very little investment is taking place at rock-bottom interest rates, there would only very little private investment to crowd out in the first place.

16. The principal Keynesian critique of the monetarist framework is that a government that tries to boost real GDP Y by boosting the money stock will induce an offsetting collapse in the velocity of money V and so have little if any effect.

   a. Under what conditions is the Keynesian critique likely to be right?

   The Keynesian critique is likely to be right when there isn't any excess demand for money and when demand for money is elastic. Then increases in the money stock are unlikely to make households eager to spend more, and are likely to have effects only by lowering interest rates slightly and by the effect of those lowered interest rates on businesses' desires to issue bonds and increase their investment spending.

   b. Under what conditions is the Keynesian critique likely to be wrong?

   The Keynesian critique is likely to be wrong when there is great excess demand for money—when interest rates are high and demand for money is inelastic. Then increases in the money stock are likely to have big effects on desired spending.

17. Minskyites tend to say that both Keynesians and monetarists are wrong--at least in dealing with deep depressions. From their perspectives, attempts to boost either the economy's money stock or the planned amount of (risky) investment in building firm capacity are likely to fail to relieve depression.

   a. What is the Minskyite story for why normal monetarist attempts to cure depression are unlikely to be completely successful?

   Normal open market operations simply swap one safe asset—short-term government bonds—for another—cash. Since it doesn't change the total quantity of safe assets, it does nothing to relieve the excess demand for safe assets that is at the root of the problem.

   b. What is the Minskyite story for why normal Keynesian attempts to cure depression are unlikely to be completely successful?

   Inducing businesses to issue more bonds or consumers to save less would be effective if the problem were an excess demand for risky bonds—then increasing the supply of bonds or decreasing the demand for bonds via reduced savings would make households and businesses eager to switch spending back from building up bonds to buying currently-produced goods and services. But the problem is the enormous risk premium between risky and safe assets—it is the shortage of safe assets that causes the cutback in spending. And attempts to boost corporate investment or reduce consumer savings will simply drive the risk premium higher and affect the shortage of safe assets little if at all.

18. Classify each of the situations below into one of our three types of depression: monetarist, Keynesian, and Minskyite:

   a. Very low interest rates on short-term and long-term government bonds, but high interest rates on risky corporate bonds and low stock prices.

      When there is a divergence in the interest rates of safe and risky bonds the downturn fits neither the Keynesian nor monetarist types. Instead, this would be an example of a Minskyite downturn, where there is excess demand for safe, high-quality assets.

   b. Very high interest rates on short-term and long-term government bonds, high interest rates on risky corporate bonds and low stock prices.

      High interest rates on all bonds means that the price (and thus the underlying demand) for bonds is low. Thus the demand for money (cash) is high. This is an example of a monetarist downturn.

   c. Very low interest rates on short-term and long-term government bonds, low interest rates on risky corporate assets and depressed stock prices.

      Low interest rates on all bonds means that the price of bonds is high, which happens when the demand for bonds is high. This is an example of a Keynesian downturn.

   d. Very low interest rates on short-term government bonds, high interest rates on risky corporate bonds, low stock prices, and high interest rates on long-term government bonds.

      When there is a divergence in the interest rates of safe and risky bonds the downturn fits neither the Keynesian nor monetarist types. Instead, this would be an example of a Minskyite downturn, where there is excess demand for safe assets (in this case, short-term government bonds). The high interest rate for long-term government bonds may reflect a feeling that the government may not be able to finance its debt obligations over the long term, so that long-term government bonds are not a sufficiently high-quality asset.

19. What are the chief arguments against the Minskyite proposal to cure a depression by having the government guarantee the liabilities of banks and finance companies, thus bailing them out?

   Bailouts are unfair: (relatively) innocent taxpayers foot the bill for poor decisions of (probably) greedy bankers and financiers.

   Moreover, once troubled banks and other financial are bailed out there is a serious risk of moral hazard. That is, in the future these institutions may take on even more risk because they've learned the lesson that they won't have to bear all the costs of bad luck or failure.