14.02 – PROBLEM SET #1
SOLUTION SET
SEPTEMBER 21, 1995

PROBLEM 1

1. a) *NOMINAL GDP ($Y)*:

To compute nominal GDP, multiply production of each good by its current price and sum.

$$\$Y1960 = (20 \text{ limes})(12 \text{ vrimes/lime}) + (50 \text{ chimes})(30 \text{ vrimes/chime})$$
$$= 240 \text{ vrimes} + 1500 \text{ vrimes} = 1740 \text{ vrimes}$$

$$\$Y1961 = (15 \text{ limes})(15 \text{ vrimes/lime}) + (30 \text{ chimes})(32 \text{ vrimes/chime})$$
$$= 225 \text{ vrimes} + 960 \text{ vrimes} = 1185 \text{ vrimes}$$

Note that the final answer is in units of currency, in this case, vrimes.

REAL GDP (Y):

To compute real GDP, multiply production of each good by its base year price and sum.

Base Year =1960:

$$Y1960 = \$Y1960 = 1740 \text{ vrimes}$$
$$Y1961 = (15)(12) \text{ vrimes} + (30)(30) \text{ vrimes}$$
$$= 180 \text{ vrimes} + 900 \text{ vrimes} = 1080 \text{ vrimes}$$

Base Year =1961:

$$Y1960 = (20)(15) \text{ vrimes} + (50)(32) \text{ vrimes}$$
$$= 300 \text{ vrimes} + 1600 \text{ vrimes} = 1900 \text{ vrimes}$$
$$Y1961 = \$Y1961 = 1185 \text{ vrimes}$$

Note that real GDP equals nominal GDP in the base year.

GDP DEFLATOR (P):

The GDP deflator equals nominal GDP divided by real GDP.

Base Year = 1960

$$P1960 = \$Y1960/Y1960 = 1$$
$$P1961 = \$Y1961/Y1961 = 1185/1080 \simeq 1.10$$

Base Year = 1961

$P1960 = \$Y1960/Y1960 = 1740/1900 \simeq 0.92$
$P1961 = \$Y1961/Y1961 = 1$

Note that the GDP deflator equals one in the base year and that the deflator has no units attached.

1b) The rate of inflation equals the percentage change in the GDP deflator. So, using 1960 as a base year, we have:

$$\text{Inflation} = (P1961 - P1960)/P1960 = (1.10 - 1)/1 = 0.10$$

Inflation is 10 per cent.

1c) Using 1961 as the base year, we have:

$$\text{Inflation} = (P1961 - P1960)/P1960 = (1 - .92)/0.92 \simeq .09$$

Inflation is about 9 per cent.

1d) The rate of inflation is a weighted average of the price changes of individual goods, with the weights equal to the shares of the goods in real GDP. The share of a good in real GDP is its current year quantity multiplied by its base year price, divided by real GDP. For example, using 1960 as a base year, the real share of limes in 1961 is 180/1080. Since the real share depends on the choice of base year, the rate of inflation will depend on the base year. We didn't expect this kind of answer on the problem set. You should know that the choice of base year matters for the calculation of inflation.

PROBLEM 2:

2a) The purchase of a used lawn mower merely transfers an existing good to another owner. Nothing new is produced in the economy, so this transaction is not part of GDP.

2b) There are two ways to approach this question:

i) Tires are intermediate goods in the production of cars. GDP counts only the sale of *final* goods. So the final sale of a Chevrolet to a consumer, or the addition of a Chevrolet to car dealer inventories, will be counted in GDP, but not the sale of intermediate tires.

ii) GDP is also the sum of value-added in the economy. The value-added from producing and selling tires is counted as part of GDP, as is the value-added from producing and selling the final good—in this case, a Chevrolet.

The definition of GDP as the sum of value-added is equivalent to the definition of GDP as the sum of sales of final goods. Which technique is used in practice depends upon which type of data is more convenient to collect.

Note: recall that value-added equals sales revenue minus the cost of intermediate goods.

2c) In principle, babysitting is a service that the economy produces, and thus is something that could be included in GDP. In practice, the activity of the informal economy—including family or neighborly babysitting services, among other things—is not captured in the GDP accounts because there is no record of a transaction. On the other hand, if one were to open a day care center, which produces a service similar to babysitting, this activity would be included in GDP.

PROBLEM 3:

Recall that:

$\text{GDP} = Y = C + I + G + \text{inventory investment} + X - Q$

where

$X - Q =$ exports minus imports

Since the problem says that changes in inventories are zero, the only way that C+I+G can equal 104% of GDP is if X-Q = -4% of GDP. In other words, imports exceed exports and the economy runs a trade deficit.

The only way for an economy to use more goods—through consumption, investment, government spending, and additions to inventories—than it produces is to import the difference from abroad. The US economy has been running a trade deficit for the past decade and a half.

PROBLEM 4:

4a)

$YD = Y - T = Y - tY = (1 - t)Y$

$C = a + bYD = a + b(1 - t)Y$

The marginal propensity to consume, which we have defined as the fraction of an additional dollar of *disposable* income that is consumed, is equal to b. You will note, however, that the fraction of an additional dollar of income that is consumed is $b(1 - t)$, because of the proportional taxation. This will be important below.

Proportional taxation is just income taxation. Every dollar of income is taxed at some rate t, where $0<t<1$.

4b) Government spending is fixed, so we'll call it G. Likewise, investment is fixed, so we'll call it I. There are no changes in inventories. Also, we have a closed economy, so we can ignore exports and imports.

Demand $= Z = C + G + I = a + b(1 - t)Y + G + I$

Production $= Y$

Equilibrium: $Y = Z$

Substituting for Z:

$Y = a + b(1 - t)Y + G + I$

Rewriting:

$Y[1 - b(1 - t)] = a + G + I$

$Y = \left(\frac{1}{1-b(1-t)}\right)(a + G + I)$

The multiplier $= \frac{1}{1-b(1-t)}$. Recall that when T was fixed, in the text, the multiplier was $1/(1 - b)$. Since $1 - b(1 - t) = 1 - b + bt > 1 - b$, the multiplier with proportional taxes is lower than the multiplier with fixed taxes.

Think of the multiplier as the change in income resulting from an additional dollar of autonomous spending, that is, spending not related to income. For example, consider an increase in government spending, G.

In the case where T is fixed, an increase in G creates a direct increase in income, which in turn increases disposable income, YD. Part of the increase in disposable income is consumed, which creates more income, which creates more disposable income, and so on. The result of all this is that the initial dollar increase in G increases output by more than one dollar; hence, the multiplier.

When taxes are not fixed, but related to income, the multiplier effect is muted. At each stage in the process, disposable income does not increase by the change in Y, but by $(1 - t)$ times the change in Y. The government taxes away some of the disposable income before it can be consumed.

4c) In the closed economy, private savings must finance investment and the government deficit.

$S = I + G - T = I + G - tY$

Substituting for Y from part b:

$S = I + G - t(\frac{1}{1-b(1-t)})(a + G + I)$

4d) Since $Y = (\frac{1}{1-b(1-t)})(a+G+I)$, an increase in t decreases the multiplier and lowers income. The increase in t acts to reduce disposable income for every level of Y, and thus lowers consumption.

As for S, we see from part c) that the only components of S which change are t and Y. Since t increases and Y falls, it might seem that the change in S is ambiguous, but we can figure it out.

Recall that $YD = S + C$. Disposable income must either be consumed or saved.

Thus:

$(1 - t)Y = S + a + b(1 - t)Y$

$S = (1 - t)(1 - b)Y - a$

An increase in t reduces $(1-t)$ and reduces Y, so S falls. Both private saving and consumption are reduced by the tax increase. You can also get this result by taking the final equation for S in part c) and differentiating with respect to t.

4e)There are several ways one might answer this question. What is important is that your reasoning be clear and correct. Here are some thoughts.

If Y increases, total taxes increase. If one believes that the fiscal authorities are likely to spend money when they have it, G might increase. Moreover, one might believe that legal restrictions or prudence limits the size of the government deficit. When Y, and hence taxes, increase, the fiscal authorities are less bound by deficit concerns and thus spend more.

On the other hand, if the fiscal authorities are attempting to target some level of Y, than an exogenous increase in Y could lead to a decrease in G

Finally, you might think that transfer payments (e.g., aid to the poor) would increase when Y falls. Transfers, however, are not part of GDP and not part of G, as we have defined it. So while total government spending as discussed in the newspapers might be affected by Y through transfers, G, government spending net of transfers, would not be affected through transfers.

PROBLEM 5.

You're on your own on this one, but if you had trouble using a spreadsheet, see the notes on XESS in Problem Set 2.