

Question 1

Remark 1. *The question didn't ask you to provide an underlying intuition behind the AD function. But I think it's very important for you to understand why the AD function is expressed in this way and how each variable affects AD.*

a) The AD equation is given by:

$$Y_t^D = a + bG_t + cM_t - cP_t + dA_t + e_t$$

This AD equation is entirely conventional.

- ⇒ The first term includes the effects of the constant autonomous expenditure such as consumption, investment, government purchase and net exports that does not change over time.
- ⇒ The second term shows separately the effect of government purchases, and shows that an increase in G leads to a rightward shift of the AD curve ($b > 0$) holding others constant.
- ⇒ The third term shows that ceteris paribus, a rise in the nominal money supply (M) will lead to a rightward shift of the AD curve ($c > 0$). This is because a monetary expansion will lead to an excess supply of money and thus firms and households will try to purchase bonds with their excess money holdings. This drives the price of bonds up and the interest rate down, which leads to more investment, consumption (and net exports if in an open economy), and thus more aggregate demand.
- ⇒ The fourth term shows that ceteris paribus, increases in the price level lead to reductions in wealth and thus to reductions in desired expenditure and less aggregate demand.
- ⇒ The fifth term includes the effects of other autonomous expenditure such as consumption, investment and net exports and shows that **an increase in A leads to a rightward shift of the AD curve** ($d > 0$).
- ⇒ The last term is the error term, which includes all other variables that is not included in the AD equation and all the possible AD shocks.

Recall that, if we held the price level constant, **the simple multiplier would be given by the amount by which a \$1 increase in G increases equilibrium GDP**. The coefficient b on G in the AD curve is precisely this simple multiplier since a \$1 increase in G leads to a rightward shift of the AD curve by $\$b$ (which would equal the increase in equilibrium GDP if the AS curve were horizontal, as is the case with the constant price level). **The same would apply to A , the other autonomous part of desired spending**. So there is **no reason not to believe** that the parameters b and d are the same. Recall that the simple multiplier is equal to $1/[1 - MPC(1 - t) + m]$, so MPC , t and m determines the value of b . An decrease in MPC , an increase in t or an increase in m all lead to a smaller simple multiplier, and thus a smaller value of b .

However, it is possible that parameters b and d are different, depending on the nature of the spending. Government spending could be on very different types of purchases than autonomous consumption. For example, the government may fund building roads or pay civil servants, while autonomous consumption may be on household necessities such as food.

b) Interest rates do not appear in the first equation because they are not determined explicitly in this model but are determined implicitly in the money market. For a given real money supply (M/P), each real GDP is associated with one real interest rate. Thus there is no need to separately include the

variable as it would be redundant. c is the aggregate demand sensitivity to the real money supply. It is determined by the interest sensitivity of money demand ($\Delta M/P \rightarrow \Delta r$) and interest sensitivity of aggregate demand ($\Delta r \rightarrow \Delta I, C$).

What matters here is the real terms! We can rewrite

$$Y_t^D = a + bG_t + c(M_t/P_t) + dA_t + e_t$$

and the third term shows that

- ⇒ **for a given nominal money supply (M), a rise in the price level reduces the real value of money (M/P) and, through this reduction in wealth, leads to less consumption and thus less aggregate demand.**
- ⇒ **for a given price level, a rise in the nominal money supply (M) reduces interest rate, which leads to more investment, consumption (and net exports if in an open economy), and thus more aggregate demand.**

c) Any aggregate demand shock that cannot be captured by the variables in the AD equation is represented by e . For example, firms' decreased investments due to "animal spirits" is a negative AD shock, and a reduction in corporate income-tax rates is a positive AD shock. Large-scale decline in the value of stock markets is a negative AD shock, which leads to declines in the wealth of the households and firms who own shares of the companies whose stock-market value declines. This then has a negative effect on desired aggregate spending - such as a reduction in desired consumption spending for any given level of real GDP. In addition, large and sudden stock-market declines often lead to crises of confidence which generally lead to reductions in desired investment.

Remark 2. *Talking about any specific events when asked for shocks would be a better answer!*

d) The AS equation is

$$Y_t^S = \alpha + \beta P_t - \gamma W_t - \delta Q_t + \varepsilon_t$$

This is also entirely conventional.

- ⇒ The constant part α is what firms are willing to supply in aggregate when the prices are 0. This could be that it costs nothing for firms to supply the first α units of goods, or there is an aggregate stock of α units of goods available.
- ⇒ **The amount of output that firms are willing to supply increases when the price level rises ($\beta > 0$).** When firms increase output, the law of diminishing returns means that their unit costs are driven up, and so they are only prepared to provide more output at a higher price level.
- ⇒ Labour and raw materials are important inputs to the production process for many firms, and so a rise in the input prices, other things equal, leads to an increase in firms' costs. This reduces the amount of output that firms are prepared to supply.
- ⇒ The last term is the error term, which includes all other variables that is not included in the AS equation and all the possible AS shocks.

e) Any aggregate supply shocks that cannot be captured by the variables in the AS equation is represented by ε . For example, a new discovery of deposits of raw materials is a positive AS shock and labour strike is a negative AS shock. A reduction in corporate income-tax rates is also a positive AS

shock as it has the effect of reducing firms' costs and thus leads them to supply more output at any given price level.

f) In equilibrium,

$$\begin{aligned}
 Y_t^D &= Y_t^S \\
 \Rightarrow a + bG_t + cM_t - cP_t + dA_t + e_t &= \alpha + \beta P_t - \gamma W_t - \delta Q_t + \varepsilon_t \\
 (\beta + c)P_t &= a + bG_t + cM_t + dA_t + e_t - (\alpha - \gamma W_t - \delta Q_t + \varepsilon_t) \\
 \Rightarrow P^* &= \frac{a + bG_t + cM_t + dA_t + e_t - (\alpha - \gamma W_t - \delta Q_t + \varepsilon_t)}{\beta + c}
 \end{aligned}$$

Then, substitute into AD function, we have

$$\begin{aligned}
 Y^* &= a + bG_t + cM_t - c \frac{a + bG_t + cM_t + dA_t + e_t - (\alpha - \gamma W_t - \delta Q_t + \varepsilon_t)}{\beta + c} + dA_t + e_t \\
 &= \frac{\beta(a + bG_t + cM_t + dA_t + e_t) + c(\alpha - \gamma W_t - \delta Q_t + \varepsilon_t)}{\beta + c}
 \end{aligned}$$

or you can substitute P^* into AS function to get the exactly the same result

$$\begin{aligned}
 Y^* &= \alpha + \beta \frac{a + bG_t + cM_t + dA_t + e_t - (\alpha - \gamma W_t - \delta Q_t + \varepsilon_t)}{\beta + c} - \gamma W_t - \delta Q_t + \varepsilon_t \\
 &= \frac{\beta(a + bG_t + cM_t + dA_t + e_t) + c(\alpha - \gamma W_t - \delta Q_t + \varepsilon_t)}{\beta + c}
 \end{aligned}$$

i) An increase in M will result in a positive change in equilibrium Y and P because

$$\begin{aligned}
 \frac{\Delta Y^*}{\Delta M} &= \frac{\beta c}{\beta + c} > 0 \\
 \frac{\Delta P^*}{\Delta M} &= \frac{c}{\beta + c} > 0
 \end{aligned}$$

ii) An increase in G will result in a positive change in equilibrium Y and P because

$$\begin{aligned}
 \frac{\Delta Y^*}{\Delta G} &= \frac{\beta b}{\beta + c} > 0 \\
 \frac{\Delta P^*}{\Delta G} &= \frac{b}{\beta + c} > 0
 \end{aligned}$$

iii) An increase in Q will result in a positive change in P but negative change in Y because

$$\begin{aligned}
 \frac{\Delta Y^*}{\Delta Q} &= -\frac{c\delta}{\beta + c} < 0 \\
 \frac{\Delta P^*}{\Delta Q} &= \frac{\delta}{\beta + c} > 0
 \end{aligned}$$

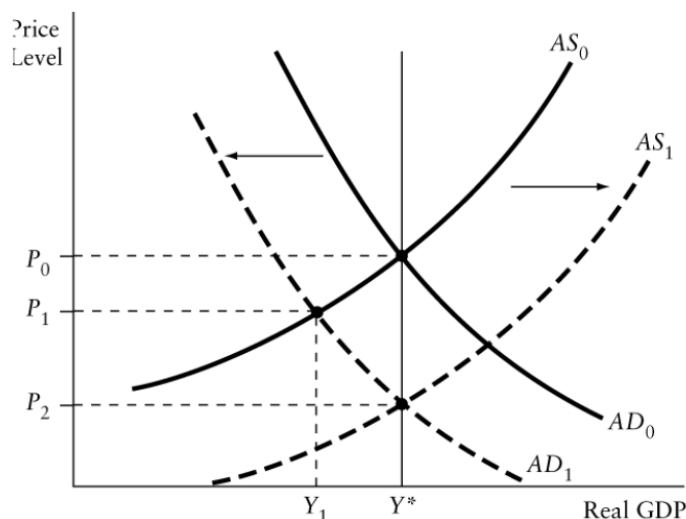
Remark 3. *If you don't know the math, explain intuitively!*

g) Use econometric techniques to estimate the AD curve:

- i) Because it usually takes one or more years for the economic consequences of the new policies to be felt, it is reasonable to include one or more lags for variables G and A.
- ii) You may encounter endogeneity problems when you use OLS to estimate the AD curve. This is because there may be some omitted variables in the error term that are correlated with G , A or M/P . This will bias the estimated coefficients.

Question 2

e) A sustained decrease in desired investment by firms is a reduction in autonomous expenditure. This is a **negative aggregate demand shock**, with the AD curve shifting to the left to AD_1 . Real GDP falls to Y_1 and the price level falls to P_1 .



f) At Y_1 , there is a **recessionary output gap**. Factors of production are used less intensively than normal, and so there is **excess supply of factors**. This excess supply forces **factor prices to fall**, thereby reducing firms' costs and shifting the AS curve downward and to the right. The AS curve shifts eventually to AS_1 , although due to **sticky wages** this adjustment may take quite a while. Real GDP eventually returns to Y^* and the price level stabilizes at P_2 .

g) If wages fall only slowly in response to excess supply, then the adjustment back to Y^* will be very slow. This means output will be below potential and unemployment will be above the natural rate (or NAIRU) **for an extended period of time**. An alternative to waiting for this natural (and slow) adjustment process is to shift the AD curve to the right through the use of an expansionary fiscal or monetary policy. In this way, output can be returned to Y^* more quickly. If wages were not sticky downwards, the adjustment would be quick and there would be less of a role for such fiscal stabilization policy.

Question 2 (a-d): Credited to Jack Burnham and Anmol Gupta

- a) Explain the basic intuition of why we might expect nominal wages to be influenced by the output gap.

Nominal wages will be influenced by the output gap as it will influence firms' demand for labour (and other factors of production). Within an inflationary output gap, firms will demand excess labour and other factors of production to produce beyond their capacity (as real output is above potential output), placing pressure on nominal wages to rise as businesses seek to attract more workers. Likewise, during a recessionary output gap, wages and other factor prices will be pressured to decline as firms will be producing below their capacity (as real output is below potential), lessening their demand for labour.

- b) What explains the lagged effect from the output gap to the change in wages? If we were estimating this equation with real-world data, is there some reason to expect that we might need more lags in the output gap in order to get a good fit with the data? Explain.

The lagged effect from the output gap to the change in wages is due to the "stickiness" of wages. Rather than wages adjusting automatically to output gaps, wages tend to rise relatively quickly and fall only slowly. This downwards "stickiness" can be explained through a variety of factors, including the long-term relationship between employers and employees, menu pricing (scenarios in which it is costly to lower wages), and the concept of efficiency wages (firms may seek to retain highly trained workers during a recessionary period), all of which would spur a slower rate of nominal wage adjustments.

If this equation were to be estimated in real life, it is likely that more lags would be necessary as changes in wages and other factor prices tend to occur slowly, particularly within the real world as firms may resist lowering wages during a recession in order to maintain employees who are highly knowledgeable of that firm's operations (particularly within a contemporary knowledge-based economy). As a result, having more lags in the output gap may allow the equation to better capture the relationship between an inflationary or recessionary gap and the rate of change of nominal wages.

- c) Why is the price level absent from our basic Phillips Curve? In general, what do you think might be a better assumption, and how would you modify the Phillips Curve appropriately?

The price level is absent from the basic Phillips Curve model as it is drawn assuming that inflation is non-existent (and thus that the rate of change of nominal wages is equal to the rate of change of real wages). However, a better assumption, given that inflation (which is the rate of change in the price level) is not absent in the real world and that workers will demand wage increases to compensate for a decline in buying power, is to plot the relationship between the rate of change in real wages (nominal wages minus the rate of inflation) and real GDP.

- d) What important economic phenomenon is reflected by the magnitude of ω ?

The economic phenomenon represented by magnitude of ω is the flexibility of wages. If the flexibility of wages is quite high (ω), then a change in the output gap ($Y - Y^*$) will produce a significant change in nominal wages as the excess demand or excess supply of labour (and other factors) leads to a large change in their prices. However, if the flexibility of wages (ω) is quite low, then the change in the output gap ($Y - Y^*$) will have a limited effect on nominal wages as the excess supply or demand for labour (and other factors of production) will not generate a significant change in their prices.

Question 3 (a-d): Credited to Jimmy Beltran, Linda Bui and Abigail Jackson

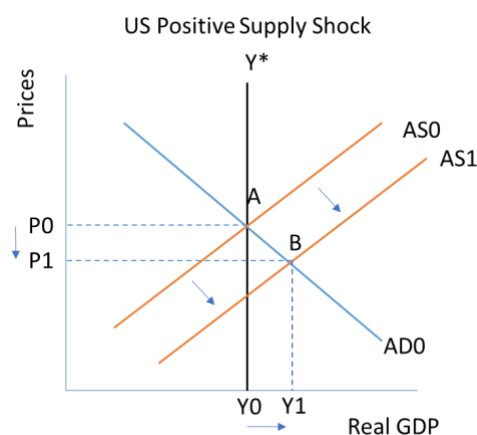
a) Consider the Phillips Curve equation in the model (stated in the previous question). What causal relationship is this equation representing, what is the direction of the causality, and what is the underlying economic logic?

Causal relationship: Changes in total output from the potential output ($Y_{t-1} = Y^*_{t-1}$) cause changes in current nominal wages (W_t). If output is positive, we can see that the current wages will also be positive and the inverse is true if output is negative.

Direction: The direction of this equation is positive. This means that an increase in the difference between Y_{t-1} and Y^*_{t-1} when $Y_{t-1} > Y^*_{t-1}$ (inflationary gap) leads to an increase in wages. Conversely, if $Y_{t-1} < Y^*_{t-1}$ (recessionary gap) then it will lead to a decrease in wages.

Economic logic: When there is a recessionary gap, there will be excess supply for labour and other factor prices leading to downward pressure on wages. The opposite is true: when there is an inflationary gap, there is excess demand for labour, leading to upward pressure on wages.

b). Explain, and show in a diagram, the short-run impact of such a “positive supply shock” on real GDP and the price level in the United States. What is the impact on the measured rate of inflation?

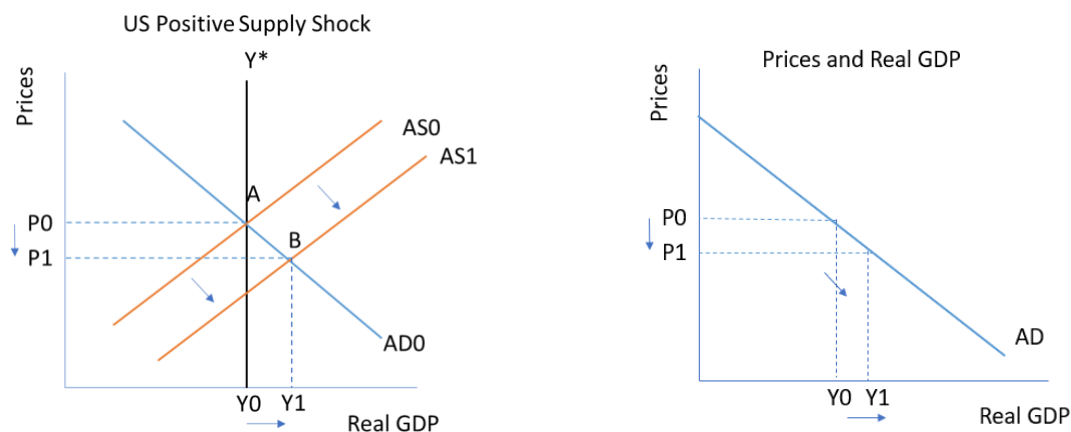


SR impact: In the short run, the positive supply shock leads to a shift in the AS curve from AS_0

to AS1, increasing Real GDP Y_0 to Y_1 as firms' input prices are lower and they are able to produce more. An increase in aggregate supply ultimately leads to production above Y^* , leading to a positive output gap. The increase in supply causes the price level to decline from P_0 to P_1 (in the short run).

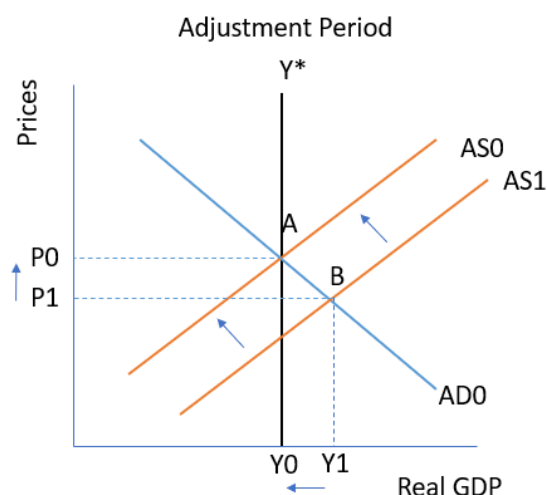
Impact on the measured rate of inflation: All else being equal, the decline in prices due to lower input price of materials leads to a shift in aggregate supply from AS_0 to AS_1 . This leads to a situation of temporary deflation in prices. Relatedly, the measured rate of inflation, the Consumer Price Index (CPI), is also deflationary/declining. It is important to note that this fall in prices is only in the short run. When the economy produces above Y^* , the inflationary output gap puts upward pressures on wages and factor prices, which will lead to long-term price increases.

d) During the time the economy is adjusting toward its new short-run equilibrium, what is the observed correlation between real GDP growth and inflation? Show this in a diagram.



There is an inverse correlation observed between real GDP growth and inflation. As prices decline, real GDP rises (see graph above, right). GDP rises because of a lower price level, which contributes to an increase in aggregate demand. This can also be seen in the graph of question b (shown above, left) - in which a decline in prices (P_0 to P_1) is correlated with an expansion in real GDP (Y_0 to Y_1). The shift of the AS curve and the movement along the AD curve leads to a new short-run equilibrium (B) where prices are lower and real GDP is higher than before.

d) Now consider the longer-run effects from the same shock, during which wages are adjusting to the output gap. After the new short-run equilibrium is achieved, but while the economy is moving toward its new long-run equilibrium, what is the correlation between GDP growth and (wage and price) inflation? Show this in a diagram.



Given the creation of an inflationary output gap ($Y1 > Y0$), there is an excess demand for labour and other factor inputs, which will put upward pressure on factor prices, which slowly increase over time and into the long run. As this upward pressure on factor prices (i.e. increases in wages and input prices) causes the AS curve to shift back from AS1 to AS0, real GDP will begin to decline from Y1 to Y0 as higher input prices contribute to less production and higher price level across the economy. In this case, the correlation between GDP growth and wages and price inflation is inverse. As real GDP slows down, inflation (price and wages) will increase. This relationship will continue until factor prices are fully adjusted and the economy returns to potential GDP/ Y^* .

(f) is credited to Pangying Peng

The Phillips Curve is not dead in the previous analyses. In c), the Phillips curve does not play a part as it kicks in in the long run. In d), we can observe the effect of the Phillips Curve because the inflationary gap puts upward pressure on wages to rise.

Some economists think Phillips Curve is dead because after the 1960s they observed the effect of expectations of inflation. Output gap became no longer the only factor to determine the rate of change in wages. Even when there was no output gap, wages still rose due to expectations of inflation.

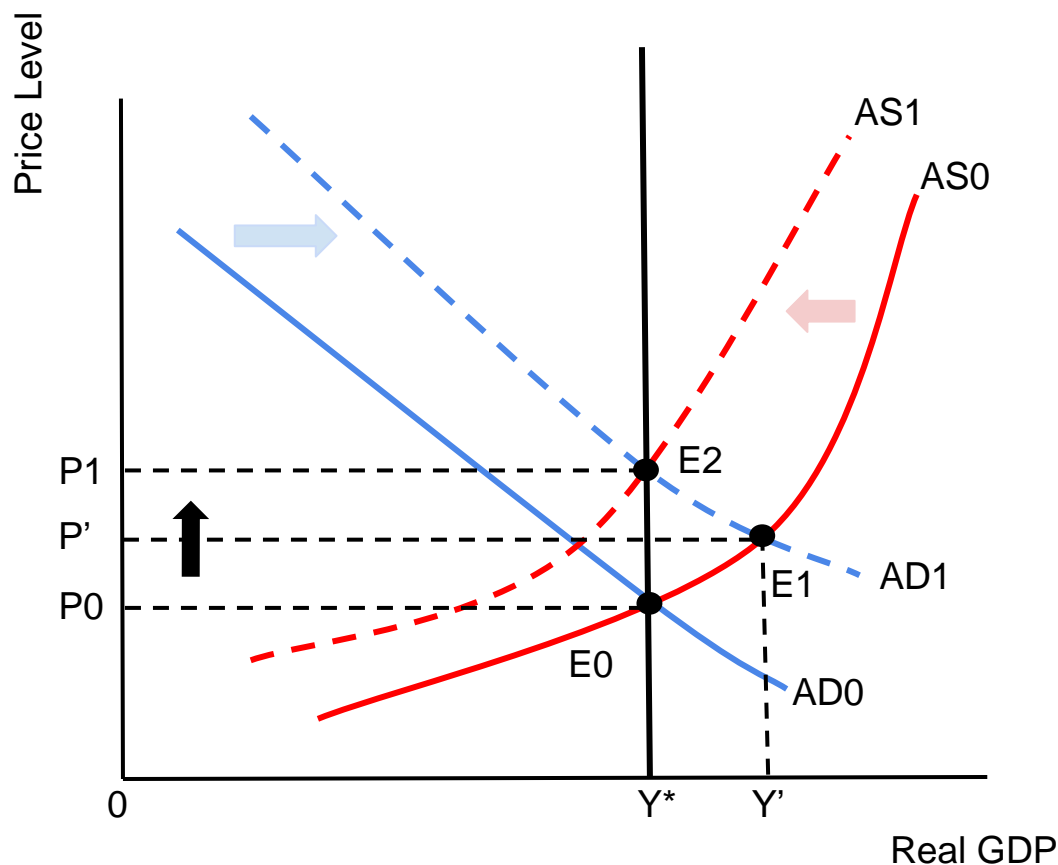
The change of monetary policy in 1990s re-anchor the expectations about inflation. Central banks began committing themselves to maintaining the inflation rate stable and low, around 2%. That explains why a period of higher-than-expected real GDP growth was accompanied by a period of lower-than-expected inflation. Today, because inflation has been stable for a long time, expectations of inflation are roughly constant,

and the Phillips curve again takes the original form of a relation between the inflation rate and the unemployment rate associated with real GDP.

Question 5. Various Issues in Fiscal Policy.

a). In the basic AD-AS macro model (with a constant Y^*), explain the effects of a large and sudden increase in government purchases, G , both in the short run and the long run. Use a relevant diagram to illustrate your argument. How does “crowding out” enter this analysis?

Partially credited to Aftab Ahmed, Megan Warsame and Harshini VN Ramesh



In the short run, a large and sudden increase in government purchases (G) will shift the aggregate demand (AD) curve to the right, resulting in an increase in both real GDP and the price level. This occurs because the increase in government purchases increases aggregate expenditures and stimulates the economy. In the long run, the increase in demand will create an inflationary gap, where excess demand for factors of production (e.g., land, labor, and capital) drives up costs and shifts the aggregate supply (AS) curve to the left. As a result, the price level will increase further, but real GDP will return to its original level (Y^*).

The rise in both the price level and GDP will lead to an increased demand for money, which drives up the interest rate. Further, the increase in interest rate will increase the cost of borrowing, crowding out some consumption and investment. Additionally, the higher interest rates will attract foreign financial capital flows, leading to an appreciation of the domestic currency. This appreciation could reduce exports and increase imports, crowding out some net exports.

b) Many economists argue that an important cost of higher government spending is the crowding out of investment which results, and the associated negative impact on long-run growth rates. Explain why the extent of crowding out depends crucially on the nature of the increase in government spending, and that in some cases there may even be an increase in long-run growth.

Credited to Janmejy Sahoo

Crowding out occurs when an increase in government spending leads to an increase in interest rate, which reduces some private expenditure (net exports, consumption and investment). However, the extent of crowding out depends crucially on the nature of the increase in government spending. For example, if the government increases its spending on public infrastructure, such as roads, bridges, and ports, this can actually increase long-run growth rates. This is because public infrastructure can improve the productivity of private firms by reducing transportation costs, increasing access to markets, and improving the quality of inputs. Moreover, an increase in government spending on research and development (R&D) can also increase long-run growth rates. R&D can lead to the development of new technologies and innovations, which can increase productivity and lead to higher long-run growth rates. In both of these cases, the increase in government spending leads to an increase in the productive capacity of the economy, which can offset the negative effects of crowding out on private investment. In fact, the increase in productivity and long-run growth rates may even lead to an increase in private investment over time, as firms become more profitable and see more opportunities for investment.

However, if the increase in government spending is on consumption rather than investment, the negative effects of crowding out may be more severe. For example, if the government increases its spending on transfer payments or social welfare programs, this is unlikely to have a significant impact on long-run growth rates, and may even reduce them if it leads to a decrease in private investment. Therefore, the extent of crowding out depends crucially on the nature of the increase in government spending, and policymakers should carefully consider the potential long-run benefits and costs of any proposed increase in government spending.

c) Explain why an economy with relatively high income-tax rates and relatively high imports will tend to be more stable in response to aggregate-demand shocks as compared with an economy with lower taxes and lower imports. Explain the role of the “multiplier” in your answer.

Credited to Emily Nickerson, Amr Soliman

$$\text{Simple multiplier} = \frac{1}{1 - z} = \frac{1}{1 - (MPC(1 - t) - m)}$$

$\uparrow \text{ net tax rate } (t) \rightarrow \downarrow z \rightarrow \downarrow \text{ multiplier}$

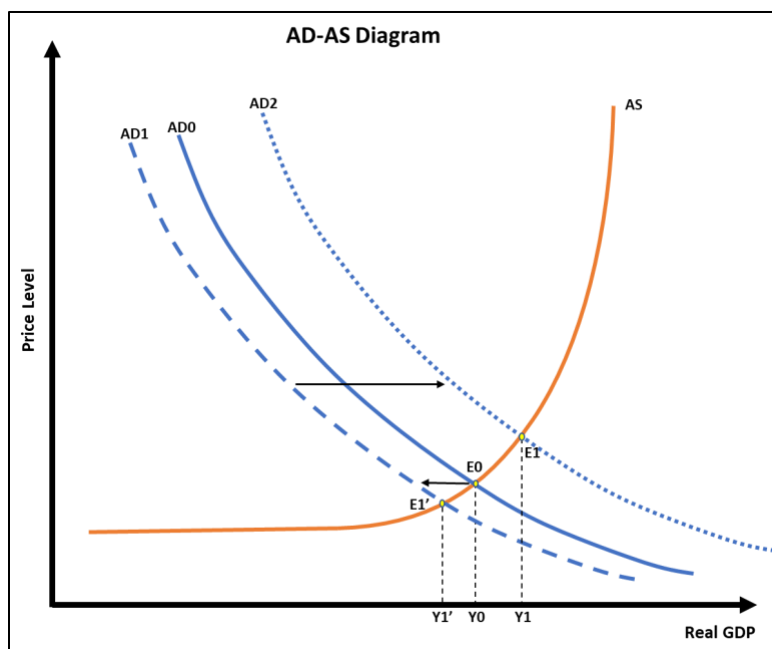
$\uparrow \text{marginal propensity to import (m)} \rightarrow \downarrow z \rightarrow \downarrow \text{multiplier}$

All other things equal, an economy with relatively high-income tax rates means that people have less disposable income and, combined with high imports which reduce expenditure on domestically produced goods and services, will lower the marginal propensity to spend (z), and decrease the size of the multiplier (flatter curve). As a result, shocks such as an increase in AD will have a dampened impact on increasing GDP. In other words, the tax system acts as an automatic stabilizer to aggregate-demand shocks. In contrast, all things equal, economies with lower taxes combined with lower imports will have a higher marginal propensity to spend and larger simple multiplier (steeper curve). In this case, given the larger multiplier, a shock will cause a bigger shift in the AD curve, and a larger change in GDP. Thus overall, these types of economies will be less stable to shocks on autonomous spending.

- d) Some economists and politicians argue that “fiscal austerity” can be an important tool for stimulating economic growth in the short run. Using the basic AD/AS model, provide an assessment of this argument.

Credited to Emily Nickerson, Amr Soliman

To achieve fiscal austerity, the government can either reduce spending or increase taxation. The scenario of austerity that might result in an economic growth in the short run is through reduction in spending. Initially, a cut in government spending would reduce aggregate demand – leftward shift AD_0 to AD_1 . However, an expectation of a long-term cut in spending could give a perception of lower taxes in the future because the size of government is shrinking. This could boost business confidence which would likely cause an increase in investment expenditure. As for households, a perception of low taxes in the future could also result in the notion of being wealthier in the future leading to the belief that there is less need to save which might also boost current consumption expenditure. If the induced increase in consumption and investment expenditure exceeds the fall in government spending, then AD would increase, surpassing the initial AD before applying fiscal austerity – rightward shift AD_1 to AD_2 . The net result would be a rightward shift in AD curve, thus equilibrium GDP would increase. However, this scenario is only true if the private sector and households are extremely forward-looking, which is not usually the case.



e) Consider a government that is planning to increase its annual purchases by \$10 billion. The plan is to spend \$5 billion on military equipment produced mostly in one region of the country, and \$5 billion on infrastructure projects in a different region of the country. Explain why a macroeconomist might argue that the composition of this spending doesn't matter very much, whereas a microeconomist (or a political advisor) might argue that the composition of the spending is very important.

Credited to Kerry Kittson

Macroeconomists study the entire economy, focusing on GDP, unemployment, inflation, among other topics. The Dividing out the \$10 billion in G in two parts of the country does not matter much to a macroeconomist, because they are looking at the big picture of the overall economy. The increase in spending activates the multiplier effect, which stimulates national income.

Microeconomists, in contrast, study the economics of individual households and firms. A microeconomist, or a political advisor, may argue that the composition of the spending is very important. If Justin Trudeau allocates \$5 billion on military equipment in Newfoundland, for example, and \$5 billion on infrastructure spending in Ontario; other provinces and territories may question why they did not receive some of this fiscal stimulus. The political advisor may recommend to spread the stimulus across more regions of the country (for example, \$1 billion to all provinces). On the households' side, microeconomists would feel that if all the fiscal stimulus benefit as many households in Canada as possible, through new jobs / employment, rather than – as in the previous statement – just certain regions of Canada. Similarly, on the

firms' side, microeconomists would likewise want as many individual firms to benefit as possible, and not just firms in a particular region of Canada.

Credited to Elizabeth Fraser

When a government is planning to increase its expenditure, it is not very important to a macroeconomist *where* that money is spent. Any spending by government (except for transfers) is autonomous spending and therefore any increase in expenditure will result in a positive aggregate demand shock and lead to changes in real GDP/level of output, the level of unemployment, and inflation in the economy. In what region that money is spent or what it is spent on will not make any difference to the degree of impact on these economy-wide factors. A macroeconomist may care more about what the composition of that spending is if the spending will lead to economic growth; a macroeconomist may preference that spending over another type. A microeconomist, and political advisors, will be much more concerned with how government spending is allocated, to which projects, and where. Microeconomists are concerned with this because their focus is on the supply and demand *in a specific sector*, whereas a macroeconomist looks at the entire economy in aggregate. Microeconomists will look at individual sectors to see what the impact would be of an increase in government spending on the price of those specific goods, the labour market for that specific sector, and the supply of that particular good or service. Microeconomists will look at where that spending is needed in individual sectors, whereas a macroeconomist will view the spending as the impact it will have on the economy as a whole. Political advisors share a similar view with microeconomists, as they are responsive to voters, who tend to think more on an individual, micro level, especially when it concerns spending in a sector that they work in. So, while political advisors will acknowledge and appreciate the macro benefits of spending on the national economy, they will want to ensure that the money is being spent in the right sectors and the right regions to ensure voters are satisfied and feel that their government is making the right spending decisions, which requires a more microeconomic perspective.

Question 6: Stabilizing the Debt-to-GDP Ratio

- a) Some economists and policy-makers argue that high levels of government debt tend to depress a country's rate of growth of real GDP. What is the apparent relationship in the data, and what is one likely causal linkage from debt to growth?

Credited to Pangying Peng

According to the 2010 study "Growth in a Time of Debt" conducted by Reinhart and Rogoff, the data showed that while the link between growth and debt seems relatively weak at normal debt levels (debt-to-GDP ratio below 90%), median growth rates for countries with public debt-to-GDP ratio over 90 percent are about one percent lower than otherwise; average (mean) growth rates are several percent lower. This relationship between public debt and growth is similar across advanced economies and emerging markets. The result

demonstrates that **after debt-to-GDP ratio rises above a threshold, it is associated with lower growth outcomes (However, this is only correlation, not causation).**

Three causal links can be used to explain the relationship between government debt and economic growth.

- First, the presence of high-level government debts may reduce the government bondholders' confidence in the issuing government's ability to repay its debts. Then the negative expectations self-fulfil and affect growth. For example, during the European debt crisis, the public debts in Greece, Portugal, Spain, and some other countries were so high that bondholders came to believe that these governments were effectively bankrupt, and would be unable to repay or even service their existing debts. Expectations for debt defaults by these governments led to massive sell-off in their bonds and created great uncertainty within the Eurozone. This situation considerably decreased the prices of their bonds, increased their bond yields and interest rates. The high interest rates in turn disincentivized the investment (and consumption) within these countries. Therefore, **rising interest rates induced by loss of confidence from government bondholders may curb domestic investment.**
- Second, if taxpayers are forward-looking, they might believe that high level of government debt signals a future increase in government tax. In this scenario, households and firms will reduce their consumption and investments, which reduces aggregate demand and thus the rate of growth of real GDP.
- Third, high-level debts also significantly curbed a government's ability to use monetary and fiscal policies to stimulate the economic growth, because these policies could cause either inflation ("debt monetization" problems), or perceptions of the government's fiscal sustainability (as more debts are added on).

(b-e) are credited to Danielle Appavoo

- b) The primary budget deficit is the total government spending less the net tax revenue (debt service payments are not included in the primary budget deficit). For this government in 2020, the primary budget deficit is 6.5% of GDP (see calculation below).

Primary Budget Deficit = Total Budget Deficit – Debt Service Payments

Primary Budget Deficit = 11.0% – 4.5% = 6.5%

The primary budget deficit is the best measure of the current debt situation because it removes the non-discretionary aspect of the deficit (the debt service payments) and shows only the discretionary parts (government spending and net tax rate) that the government has some control over.

- c) First calculate the change in debt-to-GDP ratio:

$$\begin{aligned}\Delta d &= x + (r - g)d \\ \Delta d &= 6.5\% + (4.0\% - 2.0\%)(125\%) \\ \Delta d &= 0.065 + (0.04 - 0.02)(1.25) \\ \Delta d &= 0.09 = 9.0\%\end{aligned}$$

$$d_{\text{End of 2020}} = d_{\text{Start of 2020}} + \Delta d = 125\% + 9\% = 134\%$$

The change in debt-to-GDP ratio is 9.0%, therefore the country's debt-to-GDP ratio at the end of 2020 is 134%.

- d) To hold the debt-to-GDP ratio constant at 125%, the change in debt-to-GDP ratio would need to be 0% and the primary budget deficit calculated in part (b) would need to be balanced out. Therefore, a fiscal adjustment of 9% would be needed (see calculation below). This means the government would need to reduce the primary budget deficit by 9% of GDP by reducing government spending and/or increasing the net tax revenues.

$$\begin{aligned}\Delta d &= x + (r - g)d \\ 0\% &= x + (4.0\% - 2.0\%)(125\%) \\ x &= -(0.04 - 0.02)(1.25) = -0.025 = -2.5\%\end{aligned}$$

$$\text{Fiscal adjustment} = \text{Primary budget deficit} + x = -6.5\% - 2.5\% = -9.0\%$$

- e) The two different fiscal approaches to making the contractionary fiscal adjustment estimated in part (d) are:
- Reducing government spending
 - Increasing net tax revenues

They are both difficult to do economically because they could reduce aggregate demand and therefore reduce real GDP. When you reduce government spending or net tax rate (t), the short run effect will be to reduce real GDP. A reduction in t will reduce the size of the simple multiplier. They are both also politically challenging because raising taxes and reducing spending directly impacts the lives of everyday people (and everyday people are voters). Anything unpopular with voters is politically challenging.

(f) is credited to Isabel Diavolitsis and Danielle Appavoo

Efforts to sharply reduce the primary budget deficit may include cuts in government spending and/or increased taxes. These measures lead to lower demand for goods and services in the

economy and slower overall economic growth due to decreased economic activity. Decreased economic activity also means less revenue from taxes & may also increase government spending on certain programs like unemployment protections, further adding to the effect. All of this causes a decrease in real GDP greater than the decrease in debt, resulting an increase in the debt-to-GDP ratio.

This relates to the concept of the fiscal multiplier, which measures the change in real GDP resulting from a change in real government spendings. When the multiplier is high, changes in government spending or taxes lead to large changes in economic activity. Thus, if the multiplier is high, efforts to reduce the primary budget deficit may lead to an increase in the debt-to-GDP ratio, offsetting the fiscal austerity's intention. This is especially a concern in the short run because the size of the multiplier is larger in the short run than the long run. It is very possible that, in the long run, the multiplier effect is close to 0. In the long run, there could be a "crowding in" effect on private investment because of the lower interest rate resulting from the fiscal contraction. This "crowding in" could potentially generate long run growth.