ECON 3123: Macroeconomic Theory 1

Problem Set #2

Due Date: March 24, 2020

1. ATMs and credit cards (Blanchard (2017), #7 on p.104)

This problem examines the effect of the introduction of ATMs and credit cards on money demand. For simplicity, let us examine a person's demand for money over a period of four days.

Suppose that before ATMs and credit cards, this person goes to the bank once at the beginning of each four-day period and withdraws from her savings account all the money she needs for four days. Assume she needs $4 per day.

(a) How much does this person withdraw each time she goes to the bank? Compute this person's money holdings for days 1 through 4 (in the morning, before she needs any of the money she withdraws).

Day 1: $16, Day 2: $12, Day 3: $8, Day 4: $4.

(b) What is the amount of money she holds in the morning, on average?

$\frac{\$16+\$12+\$8+\$4}{4} = \$10.$

Suppose now that with the advent of ATMs, this person withdraws money once every two days

.

(c) Recompute your answer to part (a).

Day 1: $8, Day 2: $4, Day 3: $8, Day 4: $4.

(d) Recompute your answer to part (b).

$\frac{\$8+\$4+\$8+\$4}{4} = \$6.$

Finally, with the advent of credit cards, this person pays for all her purchases using her card. She withdraws no money until the fourth day, when she withdraws the whole amount necessary to pay for her credit card purchases over the previous four days.

(e) Recompute your answer to part (a).

Day 1: \$0, Day 2: \$0, Day 3: \$0, Day 4: \$16.

(f) Recompute your answer to part (b).

$\frac{\$0+\$0+\$0+\$16}{4} = \$4$.

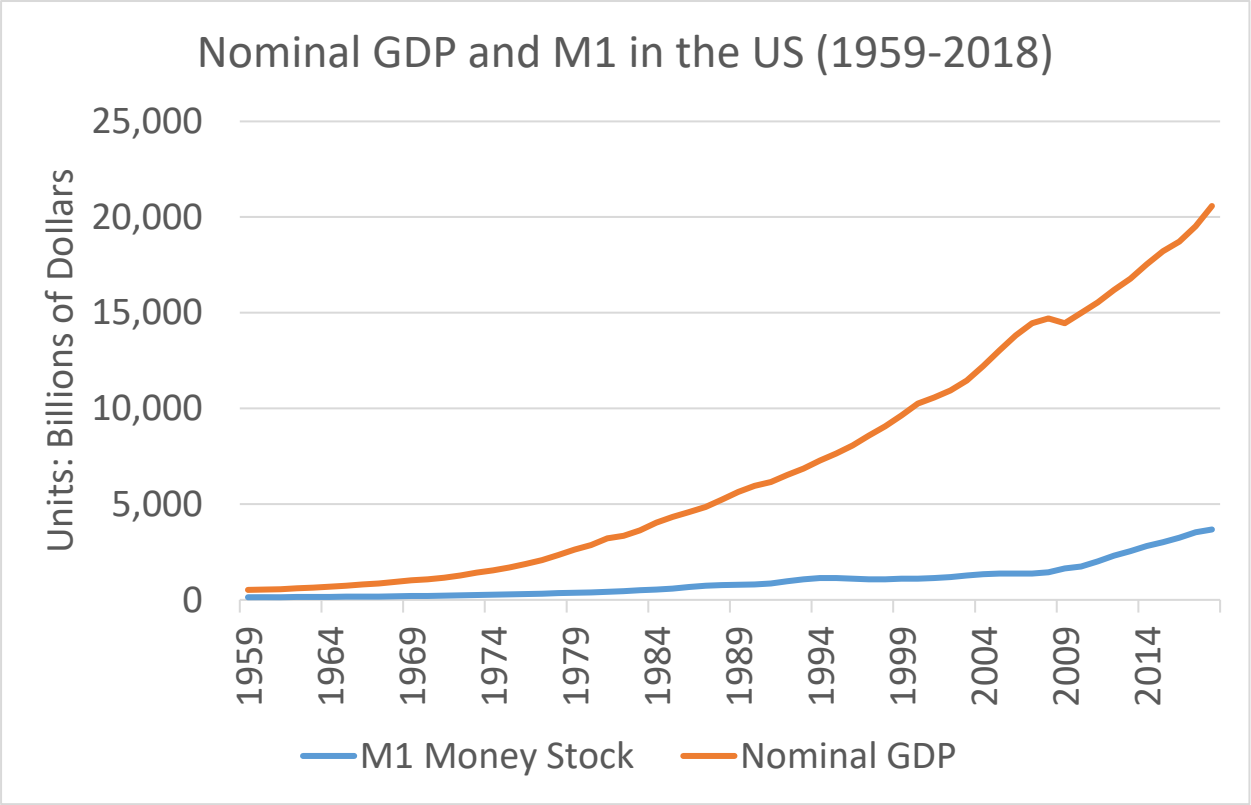
(g) Based on your answers to parts (b), (d), and (f), what do you think has been the effect of ATMs and credit cards on money demand? How about velocity?

M^d decreases as transactions technology develops. That is, with a better transaction technology, a smaller amount of M^d can support the same amount of transaction $\$Y$. Therefore, the velocity $V = \frac{Y}{M^d}$ increases.

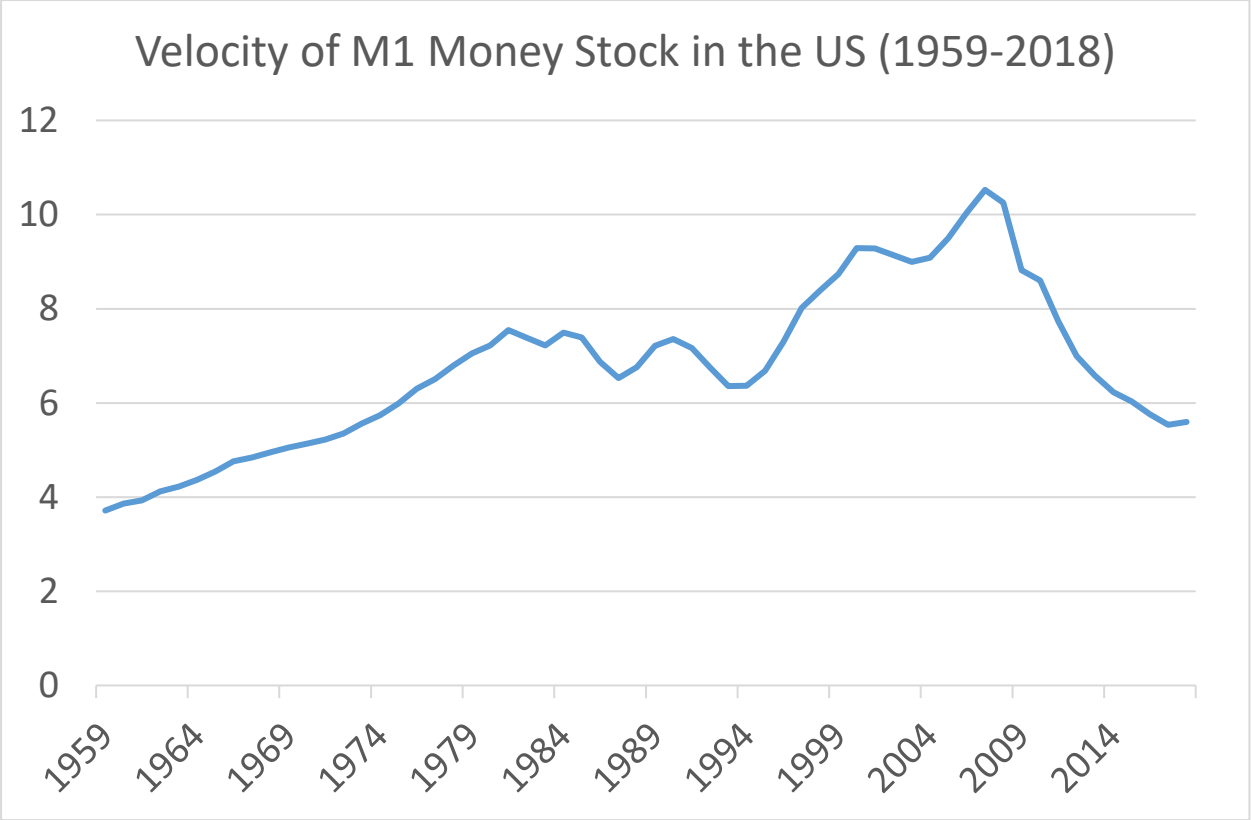
2. The velocity of money

*Here, you will check your conclusion from the above question using real world data. Specifically, we will look at the US data which can be downloaded from the FRED (*https://fred.stlouisfed.org/*), which is maintained by the FRB of the St. Louis.*

(a) Download annual data on nominal GDP and money stock M1 in the US from 1959 to 2018. For the nominal GDP, you can use the following link (https://fred.stlouisfed.org/series/GDPA). For the money stock, use this link (https://fred.stlouisfed.org/series/M1SL). Make sure that the data are at the annual frequency before you download. You can click 'EDIT GRAPH' and modify the frequency to 'Annual' by taking an 'Average' of the monthly data in each year. Create a chart showing both GDP and M1 on the same graph. Add legend, specify the name of variables, and clarify the unit of measurement.



(b) Calculate the velocity of M1 money stock in the US from 1959 to 2018. Draw a figure showing the evolution of this variable from 1959 to 2018. Add the title "Velocity of M1 Money Stock in the US (1959-2018)."



(c) Do you find the historical pattern in the velocity before 2008 is consistent with your prediction in 1.(g)? (The reason why the velocity starts to decrease since 2008 is because the Fed started to increase money supply dramatically as a form of the unconventional monetary policy. Interested students may want to read Section 23.4, although this section is beyond the coverage of this course.)

Yes. The velocity based on M1 Money stock and the nominal GDP in the US shows an upward sloping trend since the 1960s until the beginning of the Great Recession in 2008. This is consistent with the result in 1.(g). As transaction technology improves, the velocity also rises.

3. A policy mix in the IS-LM model

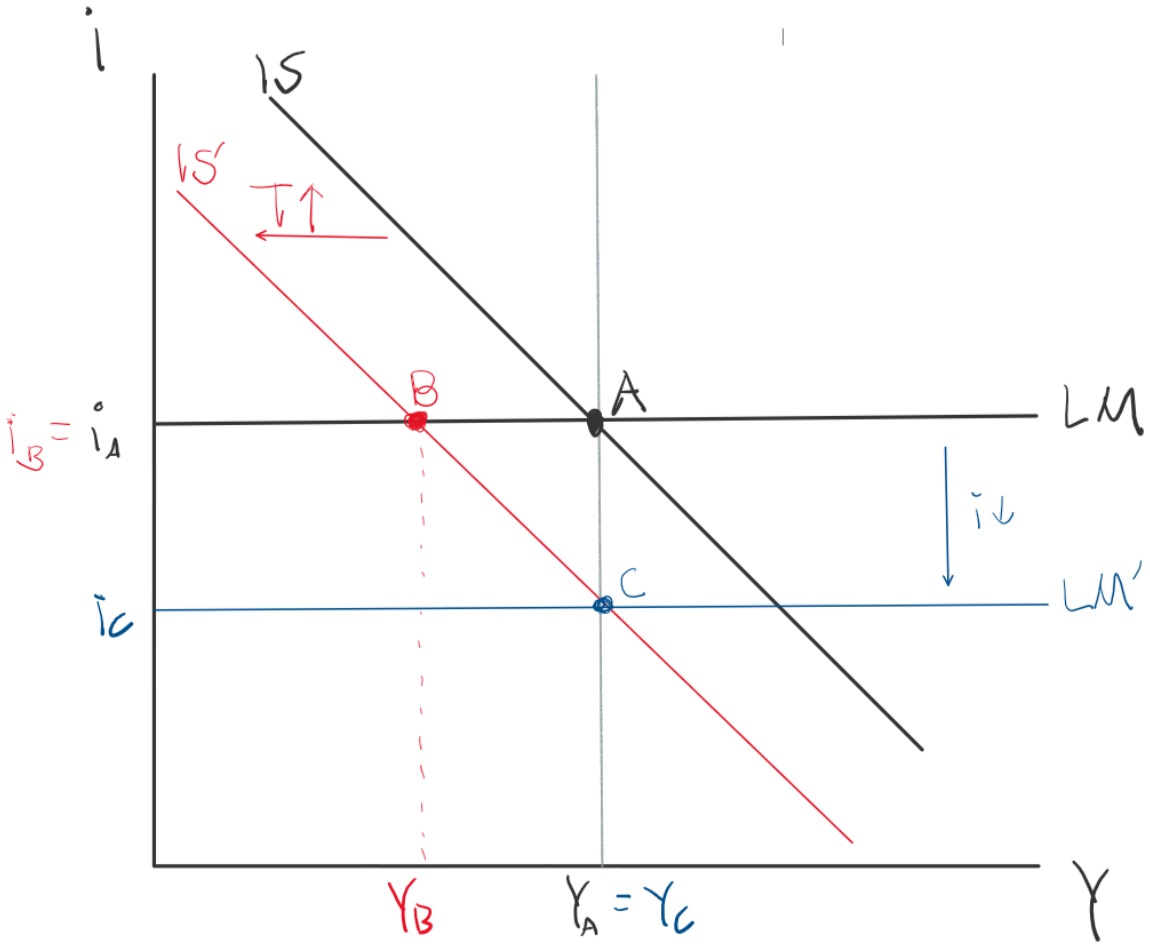
When you draw a diagram below, label all curves, lines, axes, and relevant points clearly.

(a) Draw an IS-LM diagram. Denote the point representing the current economic situation as point A.

(b) Now, the government raises T to reduce the primary budget deficit without affecting G. Explain any changes in the diagram. Show the new equilibrium and label it as point B.

(c) Given the fiscal policy in (b), if the central bank wants to stabilize output, what should it do in the open market? Explain your answer and show any changes graphically. The new equilibrium with the intervention from the central bank should be labeled as point C.

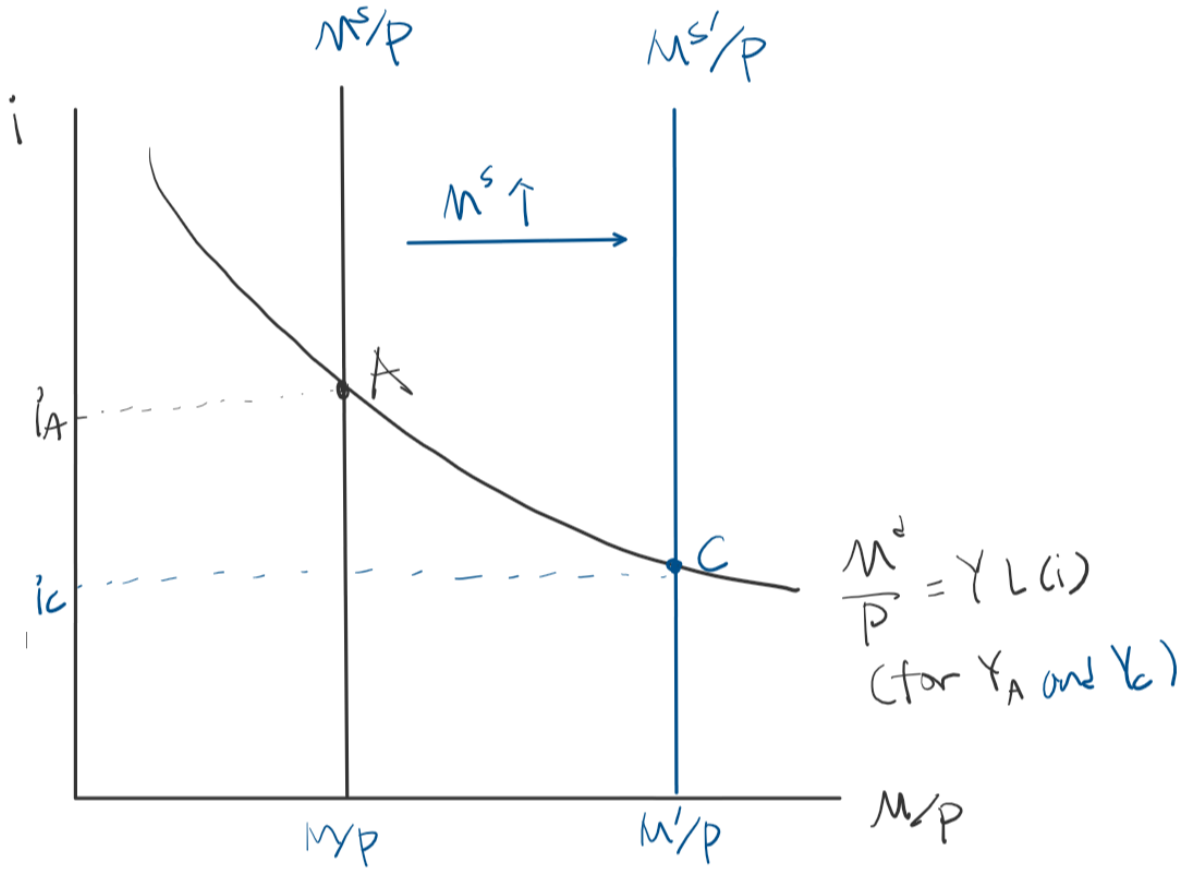
(d) Draw a money market diagram for points **A and C**. It should include real money supply and demand curves corresponding to each point A and C in the IS-LM diagram. If any curve shifts between points A and C, clearly illustrate that. Show the corresponding equilibrium interest rate as i_A and i_C.



(a) Point A represents the initial equilibrium.

(b) As T increases, the IS curve shifts to the left. Thus, at the new equilibrium (point B), output is lower. Because the central bank does not change $\bar{\imath}$, the interest rate is the same as i_A.

(c) The central bank increases the supply of money by purchasing bonds. As a result, the LM curve shifts downward to the LM'. The new equilibrium is point C, where output is equal to the initial value of output, Y_A.



(d) Because $Y_A = Y_C$, the money demand curve for points A and C is the same. To achieve $i_C < i_A$, the central bank should shift the money supply curve to $M^{s'}/P$.

4. (Blanchard (2017), #5 on pp. 127-128.)

Consider the following numerical example of the IS-LM model:

$$C = 100 + 0.3Y_D$$
$$I = 150 + 0.2Y - 1000i$$
$$T = 100$$
$$G = 200$$
$$\bar{\imath} = 0.01$$
$$\frac{M^d}{P} = 2Y - 4000i$$

(a) Find the equation for aggregate demand (Z).

$$Z = C + I + G = 100 + 0.3(Y - 100) + 150 + 0.2Y - 1000i + 200$$
$$= (100 - 30 + 150 + 200) + (0.3 + 0.2)Y - 1000i$$
$$= 420 + 0.5Y - 1000i.$$

(b) Derive the IS relation (HINT: You want an equation with Y on the left side, all else on the right.)

$$Y = Z = 420 + 0.5Y - 1000i$$
$$\Rightarrow \quad 0.5Y = 420 - 1000i$$
$$\Rightarrow \quad Y = 840 - 2000i$$
$$\therefore \quad \text{The IS Relation:} \quad Y = 840 - 2000i.$$

Note that the IS curve is downward sloping in the (i, Y) plane.

(c) Derive the LM relation if the central bank sets an interest rate of 1%.

$$\text{The LM Relation:} \quad i = \bar{\imath} = 0.01.$$

(d) Solve for the equilibrium values of output, interest rate, C and I. Verify the value you obtained for Y by adding up C, I, and G.

$$Y = 840 - 2000i \qquad \because \text{ the IS relation}$$
$$= 840 - 2000 \times 0.01 \qquad \because \text{ the LM relation}$$

$$\therefore \quad Y = 820.$$

$$\Rightarrow \quad C = 100 + 0.3Y_D = 100 + 0.3(820 - 100) = 316.$$

$$I = 150 + 0.2Y - 1000i = 150 + 164 - 10 = 304.$$

Note that $820 = Y = C + I + G = 316 + 304 + 200.$

(e) Compute $\frac{M^s}{P}$ that supports $i = \bar{\imath}$ as an equilibrium in the money market, given the equilibrium value of Y.

$$\frac{M^s}{P} = \frac{M^d}{P} = 2Y - 4000i = 2 \times 820 - 4000 \times 0.01 = 1600.$$

(f) Contractionary monetary policy. Suppose that the central bank wants to increase $\bar{\imath}$ by 1 percentage point (i.e., the new $\bar{\imath} = 0.02$). What is the impact of this contractionary monetary policy on the IS and LM curves? Find the new equilibrium values of output, interest rate, C and I. To which value the central bank should change the real money supply to make this equilibrium happen?

$$\text{The IS Relation:} \quad Y = 840 - 2000i.$$

$$\text{The LM Relation: } i = \bar{\imath} = 0.02.$$

Similar to (d), we can derive the following equilibrium values.

$$Y = 800, \qquad i = 0.02 = 2\%, \qquad C = 310, \qquad I = 290.$$

In response to the contractionary monetary policy, the LM curve shifts upward. As a result, the economy moves along the IS curve. The equilibrium output decreases and the equilibrium interest rate increases. As Y decreases, Y_D decreases, and then C also decreases. Finally, both a decrease in Y and an increase in i have a negative effect on I. Thus, I decreases.

Note that

$$\frac{M^s}{P} = \frac{M^d}{P} = 2Y - 4000i = 2 \times 800 - 4000 \times 0.02 = 1520.$$

Thus, to support this equilibrium in the money market, the central bank should reduce (real) money supply to 1520 from 1600.

(g) Expansionary fiscal policy. Suppose for now that $\bar{\imath} = 0.01$ and $\frac{M^s}{P}$ is given by the value you derive in (e). Suppose that the government increases its spending G to 300. What is the impact of the expansionary fiscal policy on the IS and LM curves? Find the new equilibrium values of output, interest rate, C and I. To which value the central bank should change the real money supply to make this equilibrium happen? What is the value of the associated government spending multiplier?

In this case, $Z = 520 + 0.5Y - 1000i$. As a result, we have the following equations for the IS and LM relations.

$$\text{The IS Relation:} \quad Y = 1040 - 2000i.$$

$$\text{The LM Relation:} \, i = \bar{\imath} = 0.01.$$

Similar to (d), we can derive the following equilibrium values.

$$Y = 1020, \qquad i = 0.01 = 1\%, \qquad C = 376, \qquad I = 344.$$

Given an expansionary fiscal policy, the IS curve shifts to the right. Thus, the economy moves along the LM curve. The equilibrium output increases. As Y increases, Y_D increases; therefore, C increases. Because Y increases and i does not change, I increases.

Note that

$$\frac{M^s}{P} = \frac{M^d}{P} = 2Y - 4000i = 2 \times 1020 - 4000 \times 0.01 = 2000.$$

Thus, to support this equilibrium in the money market, the central bank should increase (real) money supply to 2000.

Finally, $\frac{\Delta Y}{\Delta G} = \frac{1020-820}{300-200} = 2.$