Market for Federal Funds

Federal funds are excess reserves that commercial banks and other financial institutions deposit at regional Federal Reserve banks; in short-hand we will usually just say "reserves" instead of repeating "excess reserves." The rate at which federal funds can be borrowed is the **federal funds rate (FFR)**. If the FFR is higher, then banks want to lend their excess reserves aggressively to other banks to earn high interest; if the FFR is lower, the banks don't loan their money to other banks so aggressively. Ergo, downward sloping demand.

But there is more to the story. If the FFR is higher than the **discount rate**, i.e. the rate at which reserves can be borrowed from the Fed, then banks will borrow from the Fed instead. Therefore the FFR has a ceiling as determined by the discount rate.

And there's more to the story still. The Fed pays **interest on excess reserves (IOER)**. In other words, banks get paid some interest to do absolutely nothing with their reserves. If the FFR is lower than the IOER, then there is no incentive to lend to other banks; accordingly, the FFR has a floor as determined by the IOER.

The supply of federal funds is determined by the Fed through open market operations. An open market purchase increases the supply of reserves, and an open market sale reduces the supply of reserves.

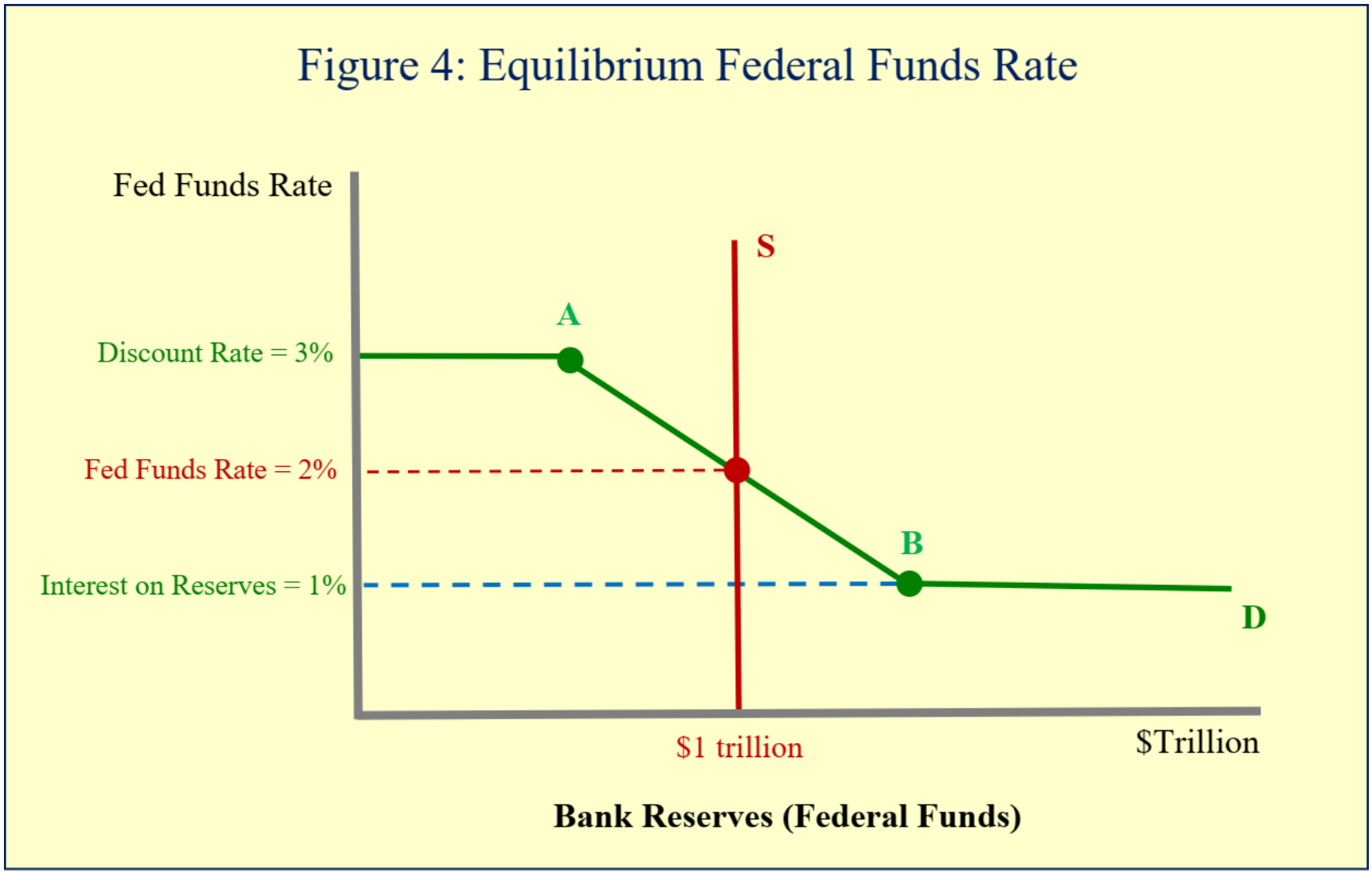
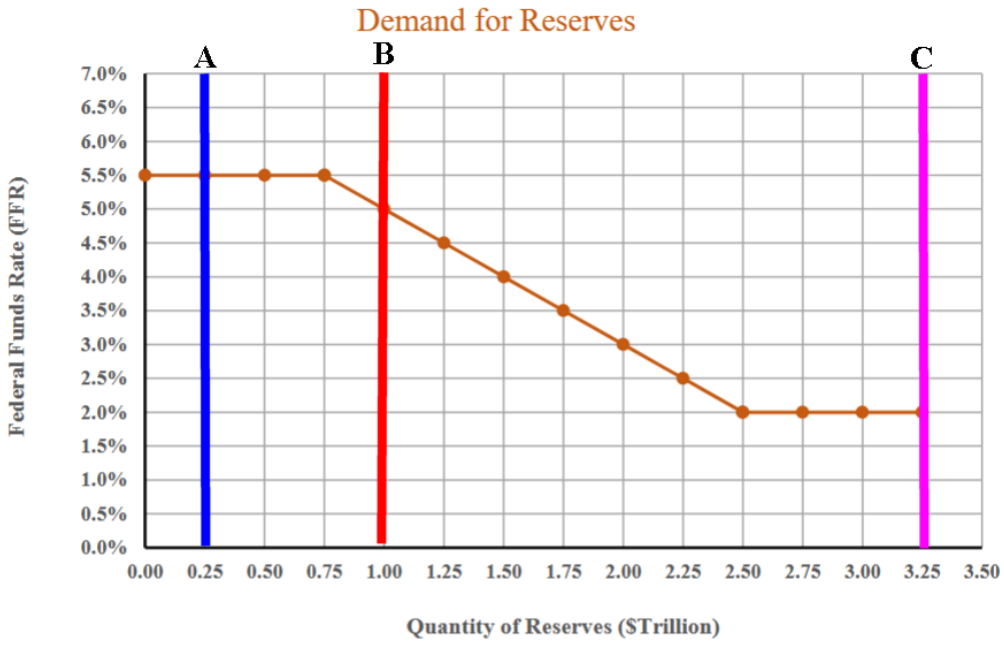


Figure 4: Equilibrium Federal Funds Rate
Fed Funds Rate
S
A
Discount Rate = 3%
Fed Funds Rate = 2%
B
Interest on Reserves = 1%
D
$1 trillion
$Trillion
Bank Reserves (Federal Funds)

Problem 1. For each of quantity of reserves shown below (A, B, and C), identify the most straightforward way the Fed can lower the federal funds rate by 1%.



Answer 1. Start with B. If the Fed does an open market purchase to increase the supply of reserves by 0.5 trillion, then FFR drops from 5% to 4%. Notice that a small open market purchase for A will not affect FFR because demand is flat there; and the Fed might be unwilling to do large open market purchases. Instead, the Fed can reduce the discount rate from 5.5% to 4.5%. At C, no amount of open market purchases can lower the FFR. Instead, the Fed can reduce interest on reserves from 2% to 1%.

Problem 2. Which of the following sequences of events characterizes expansionary monetary policy? What about contractionary monetary policy? Let C and I denote consumption and investment, respectively.

(a) fed funds rate $\downarrow \implies$ cheaper for banks to borrow reserves $\implies$ cheaper for banks to lend $\implies$ $R \downarrow$ and money supply increases $\implies$ $C, I \uparrow$

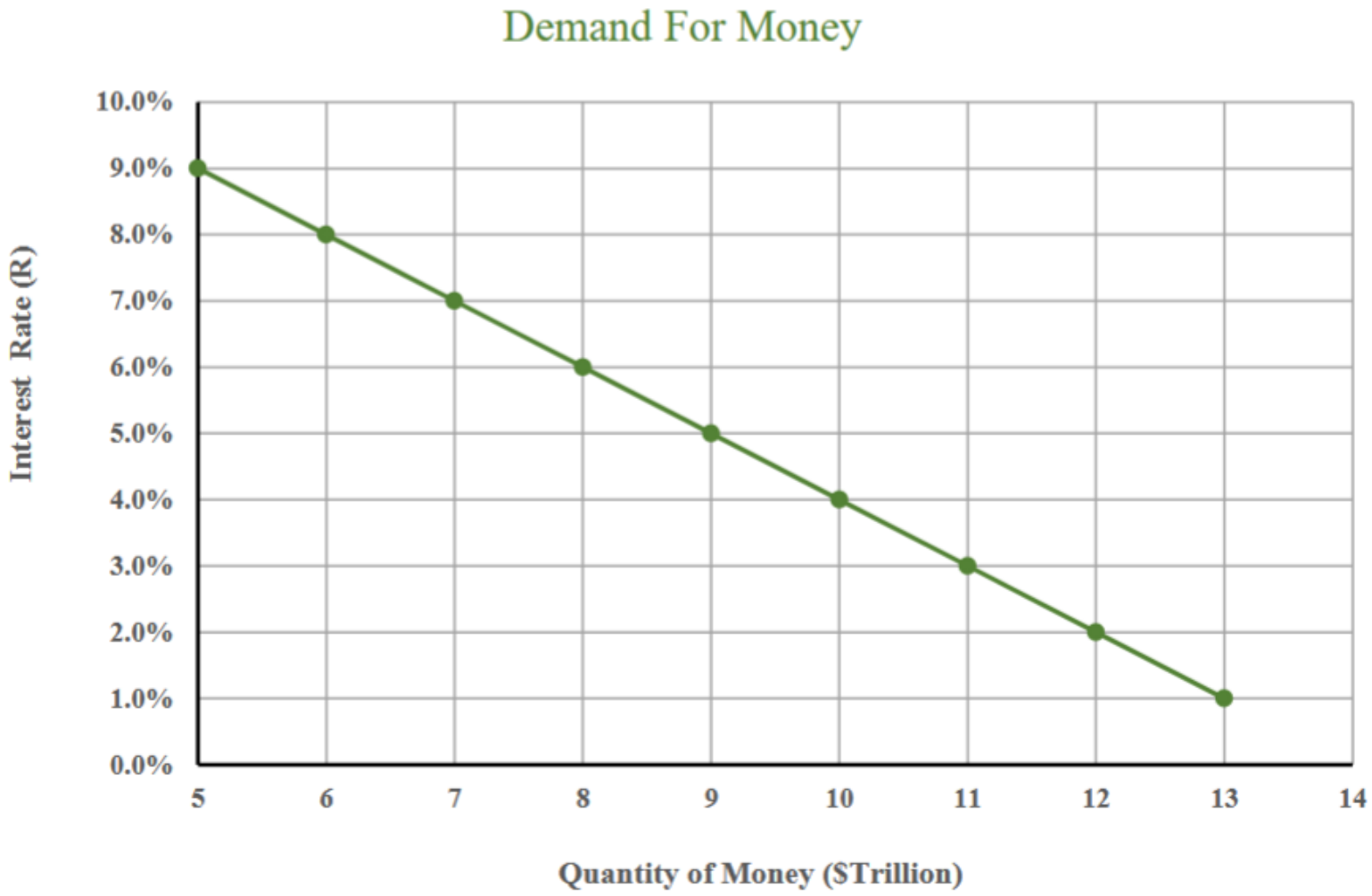
(b) fed funds rate $\downarrow \implies$ more expensive for banks to borrow reserves $\implies$ cheaper for banks to lend $\implies$ $R \downarrow$ and money supply increases $\implies$ $C, I \uparrow$

(c) fed funds rate $\uparrow \implies$ more expensive for banks to borrow reserves $\implies$ costlier for banks to lend $\implies$ $R \uparrow$ and money supply decreases $\implies$ $C, I \downarrow$

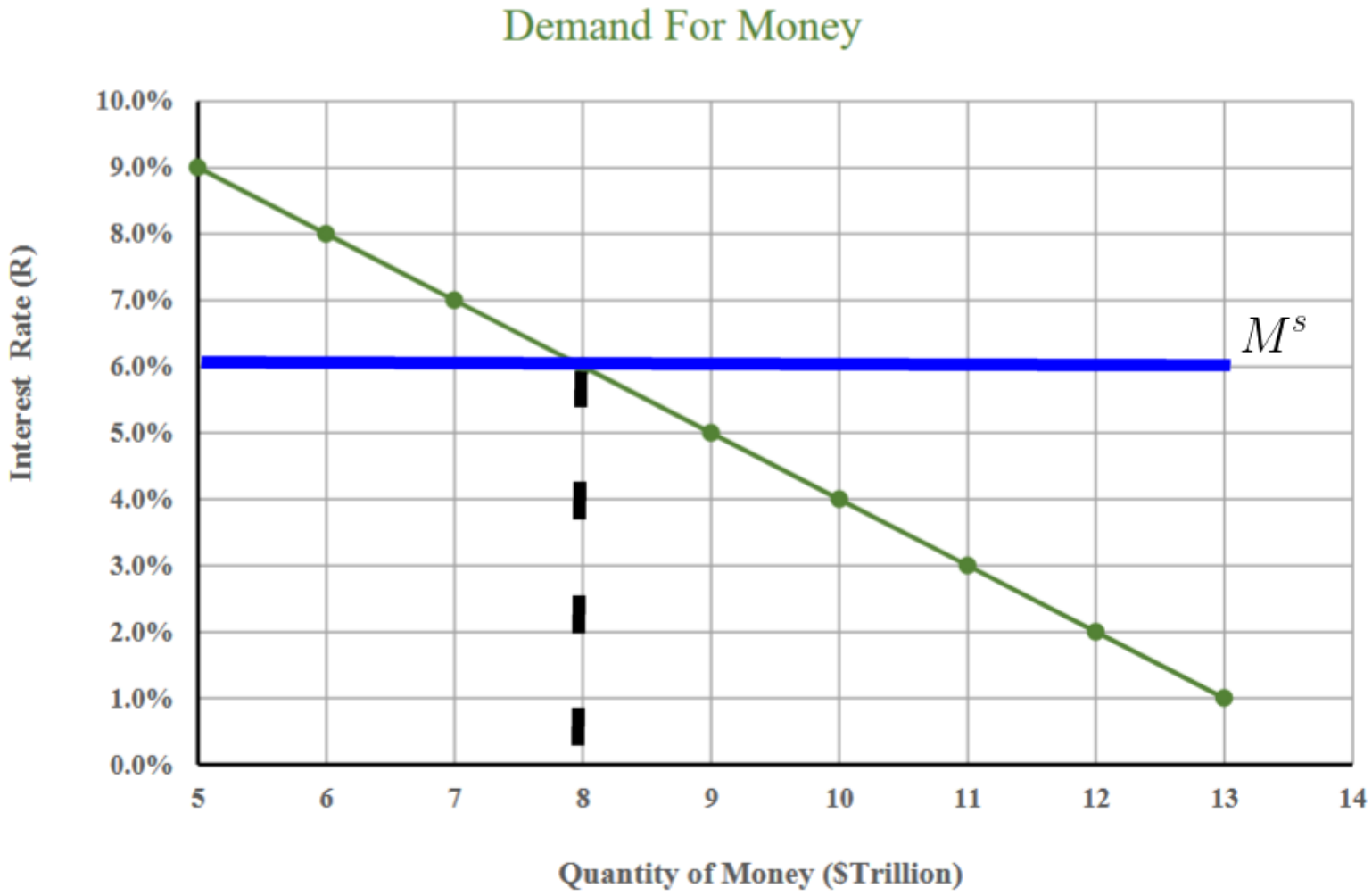
(d) fed funds rate $\uparrow \implies$ cheaper for banks to borrow reserves $\implies$ $R \uparrow$ and money supply decreases $\implies$ less lending $\implies$ $C, I \downarrow$

Answer 2: a, c. In practice a bank will borrow funds at the FFR and then lend it to us at a higher rate, which is R. The difference between the FFR and the rate we borrow at is called the **markup**, denoted m. Therefore $R = FFR + m$. The markup is what banks use to pay their employees, rent their offices, etc.

Problem 3. Refer to problem 1 and suppose the current supply of reserves is B and the markup is $m = 1\%$. Find the quantity of money using the money demand function below.



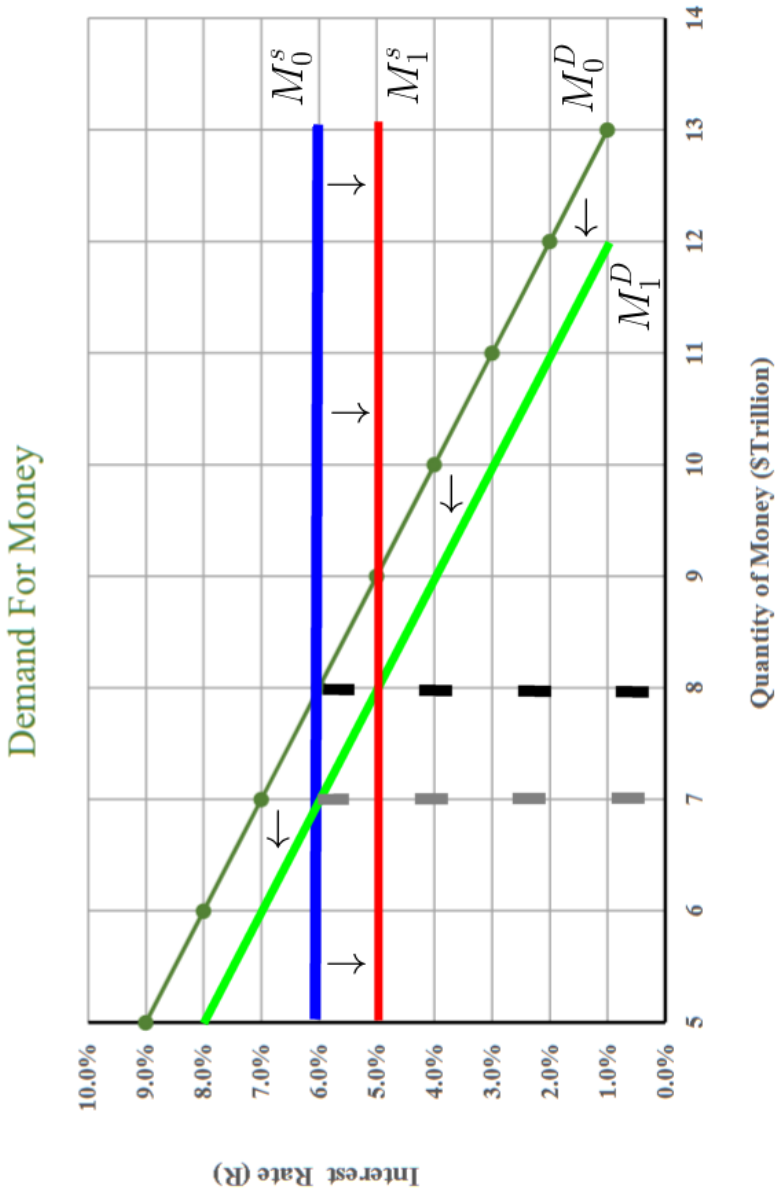
Answer 3. We know FFR = 5% and we're told $m = 1\%$, so $R = 6\%$. This value dictates the quantity of money, so we call it the money supply curve on the money market graph, shown below. The implication is that the quantity of money is \$8 trillion.



Problem 4. Refer to problem 1 and suppose the current supply of reserves is B and the markup is $m = 1\%$. Now suppose that the demand for money decreases by \$1 trillion, but the Fed wants the quantity of money to remain unchanged (because a lower quantity of money might lower the inflation more than the Fed would like). How much of an open market operation should the Fed execute?

Answer 4. Initially FFR = 5% and we're told $m = 1\%$, so $R = 6\%$. This value dictates the quantity of money, so we call it the money supply curve on the money market graph, shown below. The implication is that the quantity of money is \$8 trillion. So far this is just problem 3.

Now refer to the graphs on the next page. Demand for money decreases by \$1 trillion. This means the quantity of money falls to \$7 million. If the Fed wants the quantity of money to remain at \$8 trillion, then it will have to lower the federal funds rate by 1% so that $R = 5\%$. It can do this by increasing the quantity of reserves by \$0.5 trillion via open market purchase.


Demand For Money
Interest Rate (R)
Quantity of Money ($Trillion)
M_0^s
M_1^s
M_0^D
M_1^D
10.0%
9.0%
8.0%
7.0%
6.0%
5.0%
4.0%
3.0%
2.0%
1.0%
0.0%
5
6
7
8
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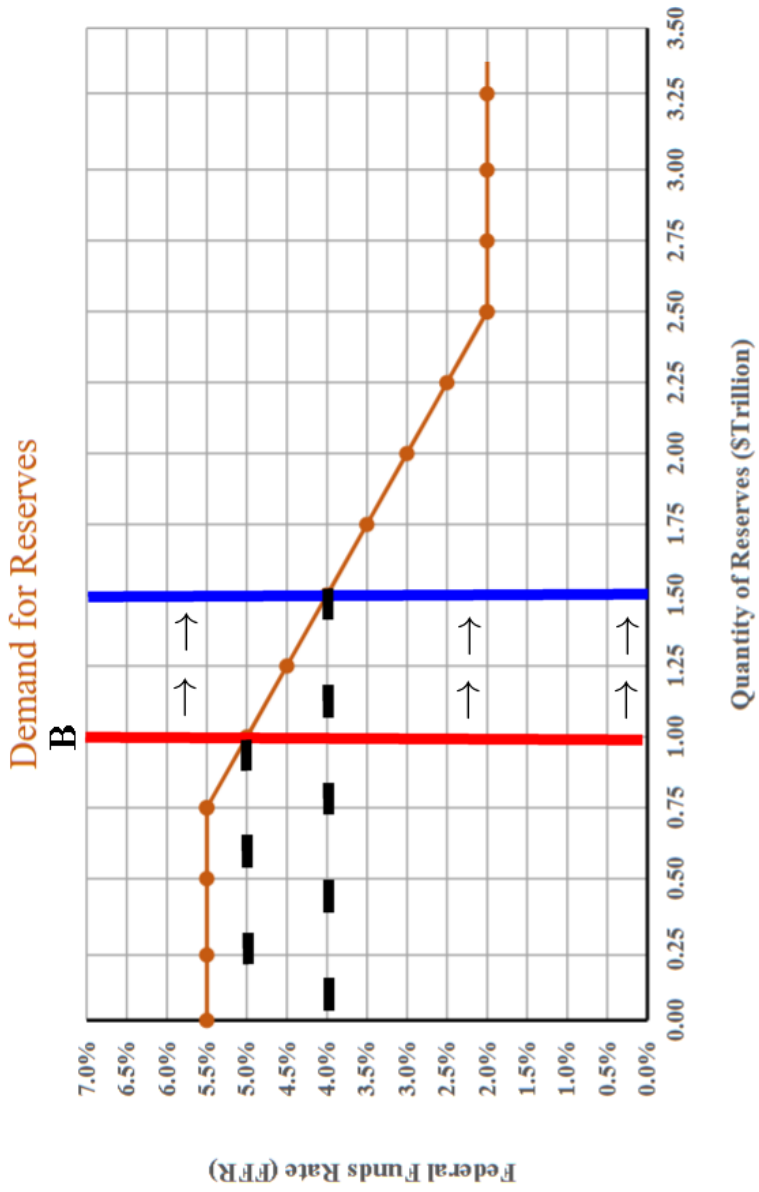

Demand for Reserves
B
Federal Funds Rate (FFR)
Quantity of Reserves ($Trillion)
7.0%
6.5%
6.0%
5.5%
5.0%
4.5%
4.0%
3.5%
3.0%
2.5%
2.0%
1.5%
1.0%
0.5%
0.0%
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
2.25
2.50
2.75
3.00
3.25
3.50

Expenditure Approach to GDP and Aggregate Demand

We've used several ways of calculating GDP. Now we focus on the expenditures approach, which says that GDP is the sum of expenditure in the following categories:

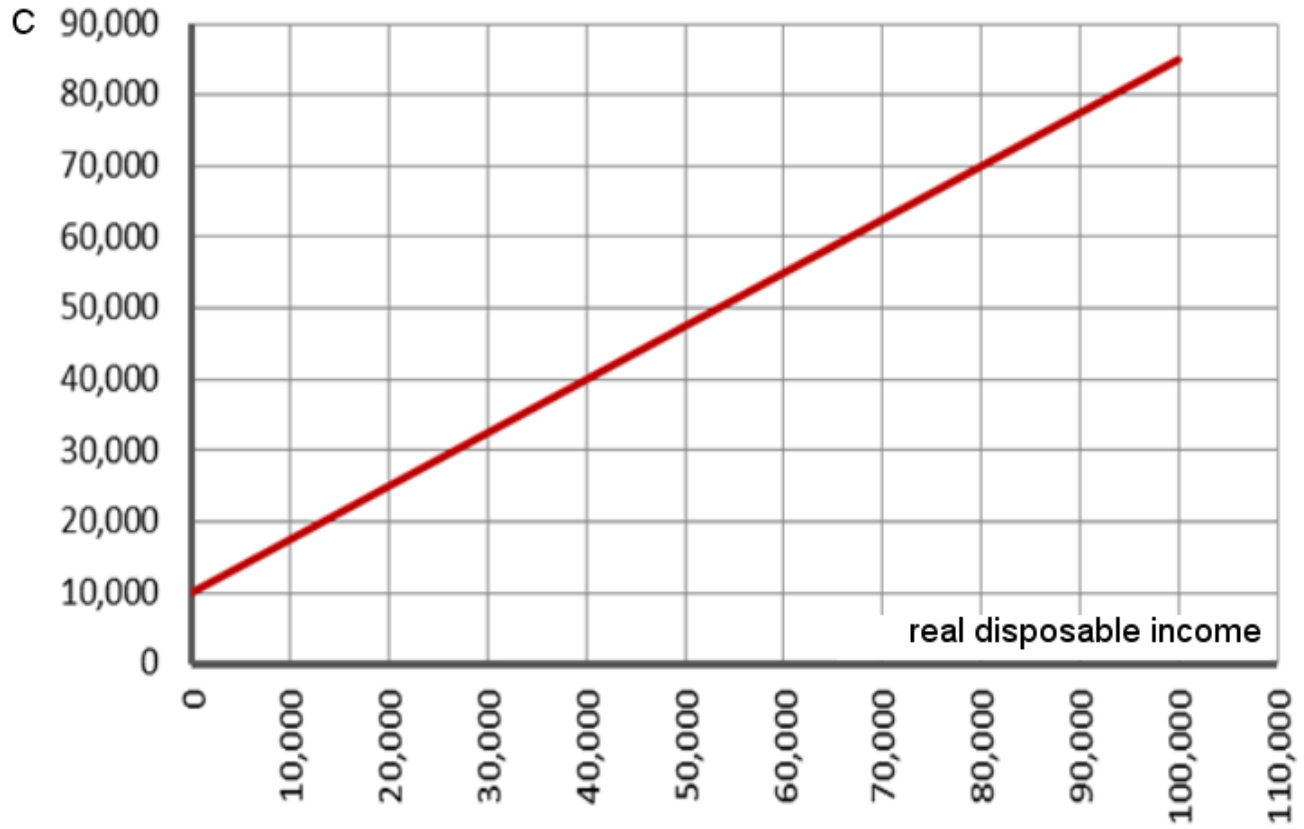
- Consumption, C
- Investment, I
- Government spending, G
- Exports, X
- Minus imports, $-IM$

In other words, $Y = C + I + G + (X - IM)$. Since a good must have been demanded in order to have generated expenditure, it's also true that $AD = C + I + G + (X - IM)$ characterizes aggregate demand. Note that $NX \equiv X - IM$ is often called **net exports**.

You might think, wait, GDP focuses only on *domestic* production, so a change in imports shouldn't change GDP. Right, it doesn't.[1] If someone imports \$100 of French wine, then we have $\Delta IM = \$100$; but a person still purchased that wine, so we have $\Delta C = \$100$, and therefore GDP is unaffected. (Or $\Delta I = \$100$ if a firm bought it.)

[1] `https://marginalrevolution.com/marginalrevolution/2019/05/gross-domestic-error.html`. You officially know more about economics than *The Economist*. Congrats.

Problem 5. The graph below shows a linear consumption function for a country. What is the marginal propensity to consume (MPC), for this country? What is the marginal propensity to save (MPS)?



Answer 5: a. The MPC is just the slope of the line. It captures how consumption changes in response to changes in disposable income Y_d. I'll pick two points that line up nicely with the grid: $(0, 10000)$ and $(40000, 40000)$. Rise over run.

$$MPC = \frac{30000}{40000} = 0.75.$$

What this means is that people will spend 75 cents of every additional (i.e. marginal) dollar of disposable income they receive. Note that what is not consumed is saved, so the marginal propensity to save is

$$MPS = 1 - MPC = 0.25$$

Problem 6. Suppose that MPC is 0.75. The government reduces taxes by 10,000 units. What is the initial effect on disposable income and consumption?

Answer 6. We first see how an increase in taxes affects disposable income, which is defined as

$$Y_d \equiv Y - TX + TR \quad \Longrightarrow \quad \Delta Y_d = \Delta Y - \Delta TX + \Delta TR.$$

We are told that $\Delta TX = -10,000$, therefore $\Delta Y_d = 10,000$.

The MPC then tells how how much consumption changes when Y_d changes, that is, $\Delta C = MPC \times \Delta Y_d$. Disposable income goes up by $10,000$, the MPC is 0.75, therefore consumption goes up by $7,500$.

Problem 7. Suppose government expenditures are increased by 100 units and the MPC is 0.75. Which of the following captures the expenditure multiplier process?

(a) $\Delta AD = 100 + 100 \times 0.75 + 100 \times 0.75^2 + 100 \times 0.75^3 + \ldots = 100 \times \frac{1}{1-0.75} = 400$

(b) $\Delta AD = 100$

(c) $\Delta AD = -100 - 100 \times 0.75 - 100 \times 0.75^2 - 100 \times 0.75^3 - \ldots = -100 \times \frac{1}{1-0.75} = 400$

(d) $\Delta AD = -100$

(e) none of the above

Answer 7: a. It's helpful to break up the narrative into different rounds of spending.

- *First round of spending*: G goes up by 100. The gov't spends that money for, say, construction, and hence that 100 becomes the income of construction workers.
- *Second round of spending*: Because the MPC is 0.75, it means the construction workers spend 0.75×100 of that on consumption, so C goes up by 0.75×100. The construction workers spend that new income at, say, the grocery store, so that 0.75×100 becomes the income of the grocery store workers.
- *Third round of spending*: Because the MPC is 0.75, it means the grocery store workers spend $0.75 \times (0.75 \times 100)$ of their new income on, say, hair transplants because the cruel mistress of time is giving their precious hairlines a smackdown. This means that C has gone up by $0.75 \times (0.75 \times 100)$.

Etc etc, ad infinitum. The total change in AD is as shown in option (a), where the sum of all rounds constitutes a *geometric series* which converges to a number called the

$$\textbf{expenditure multiplier} \equiv \frac{1}{1 - MPC}.$$

Also note that when there are changes in taxes or transfer payments, you first convert those into changes in C (like in problem 5) to get the first round of spending.

Problem 8. Suppose that MPC is 0.75. The government increases spending by $10,000$ units and pays for that additional spending by increasing taxes by 10,000 units, i.e. a *balanced budget* increase in government spending.[2] How much of a change in AD will this cause?

Answer 8. There are two first-round changes being made to AD. First, $\Delta G = 10,000$. Second, because $MPC = 0.75$, the increase in taxes means that consumption changes by $\Delta C = 0.75 \times (-10,000) = -7,500$. Therefore the total first-round change is $2,500$.

The expenditure multiplier is $1/(1 - 0.75) = 4$, so overall AD will change by $2,500 \times 4 = 10,000$. The big picture lesson is that a balanced budget change in government spending has an overall multiplier of just 1. Another way of looking at it is this: the increase in taxes cancels out the multiplier on G.

[2] This is, by far, the least realistic assumption we've made about economics in this entire course.

Inflation Target and Aggregate Demand

The Fed interprets its "price stability" mandate as having a constant and predictable rate of inflation. To that end, the Fed has an *inflation target* that it pursues, which we will denote with π^*, described officially as 2% medium-term PCE core inflation.[3]

If actual inflation is less than the target, then the Fed will pursue expansionary monetary policy to try to increase inflation back up to its target. In other words, the Fed reacts such that $\pi < \pi^* \implies R \downarrow$. The decrease in the interest rate encourages consumption and investment and therefore increases Y.

On the other hand, if actual inflation is more than the target, then the Fed will pursue contractionary monetary policy to try to decrease inflation back down to its target. In other words, the Fed reacts such that $\pi > \pi^* \implies R \uparrow$. The increase in the interest rate discourages consumption and investment and therefore reduces Y.

The conclusion is that when π increases, Y goes down; and vice versa. Such is the rationale behind the downward-sloping aggregate demand curve.

[3]PCE inflation is an alternative inflation measure that accounts for flaws in the traditional CPI measure. Core inflation removes highly volatile (i.e. noisy) prices like food and energy. The Fed does not define what "medium-term" means, which makes it (intentionally?) difficult to judge how good of a job the Fed does in pursuing its target.

Shifting Aggregate Demand

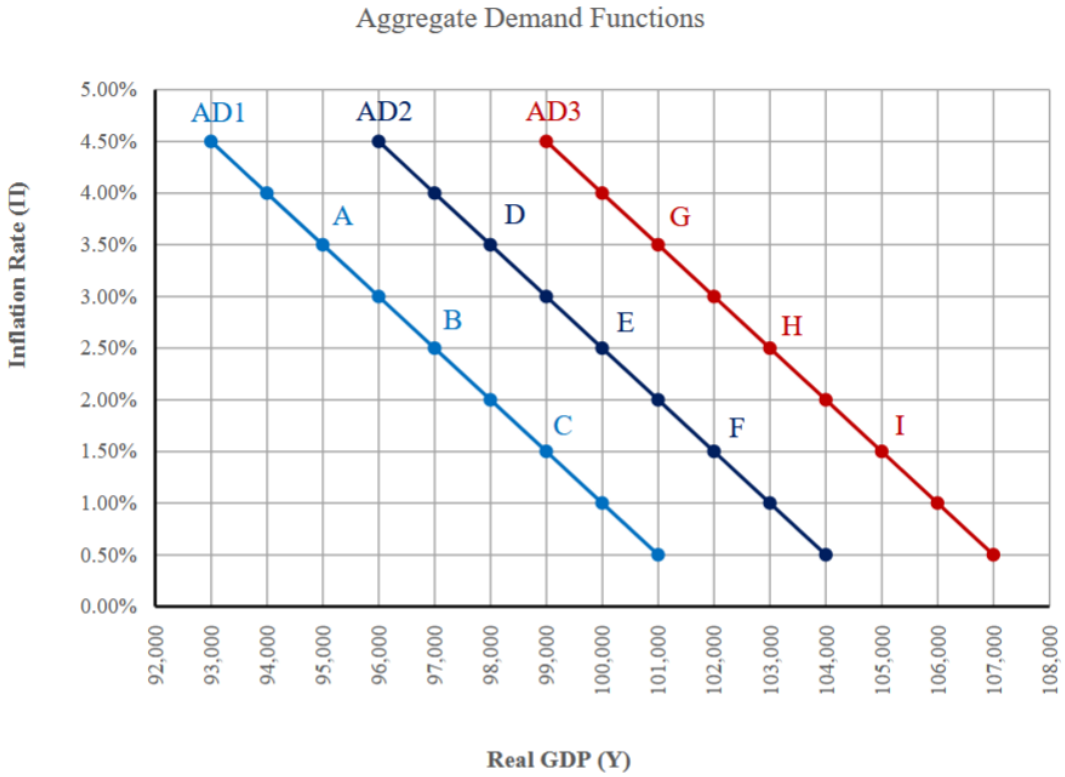
Any change other than inflation itself that affects aggregate demand will shift AD. Policy changes described below are expansionary; the opposite cases are therefore contractionary.

- **Monetary Policy 1.** If the Fed reduces the interest rate, then C and I go up and therefore AD will shift to the right.
- **Monetary Policy 2.** If the Fed increases its inflation target, then it will have to lower R to push up inflation, so then C and I go up and AD shifts to the right.
- **Fiscal Policy.** If the government increases its purchases G, then AD shifts right. If the government provides more generous transfer payments TR or reduces taxes TX, then disposable income Y_d goes up, so C goes up, and therefore AD shifts right.
- **Non-Policy Events.** Sometimes C, I, or NX will change for reasons unrelated to policy (see lecture slides for an exhaustive list). If people overseas suddenly decide that they really, really love American-made cars,[4] then American AD shifts right.

Note that fiscal policy and non-policy events do imply any difference in interest rates.

[4] Everyone in the world wants a Tesla Cybertruck so we can all look stupid together to alien observers.

Problem 9.



Suppose the economy is currently at AD2. Point E corresponds to an interest rate of $R = 7\%$ and $\pi^* = 2.50\%$. Determine if the following statements are true or false.

(a) The interest rate is lower at point F than at point E.

(b) Contractionary monetary policy shifts the economy to AD1. Point B has a higher interest rate than at point E.

(c) The stock market rallies and the economy shifts to AD3. Point G has a higher interest rate than at point E.

Answer 9.

(a) True. Inflation falls below target, so the Fed reduces the interest rate, which causes Y to increase. That's point F.

(b) True. Contractionary policy means R was increased. It follows that the interest rate at A is higher than D; at B is higher than E; and at C is higher than F.

(c) True. The shift wasn't caused by monetary policy (i.e. a change in R), so the interest rate at D is the same as at G; at E is the same as it H; and at F is the same as at I. However, points D and G correspond to higher inflation, and therefore correspond to a higher R due to the Fed pursuing its inflation target.