

Day 6: Money Market and Aggregate Supply and Demand

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1 Review: The Goods Market

Recall that in the short run that the goods market equilibrium is given by:

$$Y = c_0 + c_1(Y - T) + I + G \implies Y = \frac{1}{1 - c_1}(c_0 - c_1T + I + G)$$

The left term on the second expression is known as the multiplier. That is, for a given change in government spending, there is a change in output greater than the initial change. The goods market is important, but does not tell the whole picture, we need to incorporate the money market, which influences the goods market equilibrium through the $I = I(Y, i)$ value.

2 The Money Market and Financial markets

Money is defined as currency and checkable deposits. It is a store of value, unit of account, and medium of exchange. A store of value means that we can transfer purchasing power from present to the future. A unit of account means that people use money to compare past prices and debts. Lastly, we use it to buy goods and trade, a medium of exchange.

Like all things, there is a trade off with holding money. We can either hold money or for other assets like bonds. For simplicity, assume that we can hold only bonds. Bonds pay a positive interest rate, but cannot be used to buy things. In other words, holding money faces a price equal to the interest rate i . So we say, *the price of money is the interest rate* or the interest rate is the opportunity cost of holding money.

In the money market, nominal money supply has to equal nominal money demand. We write this as:

$$M^s = M^d$$

Let us define total demand for money as

$$M^d = \$Y f(i)$$

This equation says that total demand for money equals nominal income ($\$Y$) times a function the interest rate. For a given increase in the interest rate, the demand for money decreases. For an increase in nominal income, the demand for money increases.

2.1 Money multiplier

The money supply is set by the central bank M^s . This assumption ignores the banking system completely. In reality, we have that nominal money supply is given by:

$$M^s = multiplier \times M_C^s$$

There is a money multiplier associated with the money supply when we introduce the banking system. That is for a given \$1 increase in money supply by the Federal Reserve, the nominal money supply increase by more than \$1.

To understand this consider the following example. Suppose you have \$100. You decide to spend \$50 to buy a video game, so you have \$50 on hand to buy the video game and \$50 in the bank to save money.

The bank has \$50 initially. If the reserve ratio, the ratio at which a bank must have on hand in checkable deposits, is 10%, the bank will keep \$5 on hand and loan out \$45. On the books, the money the bank has is still \$50. It has \$50 in liabilities to you or on assets of \$45 loans and \$5 reserves. When I check my bank account, my balance should still be \$50 regardless of the loan. So the money supply is $M^s = \$50$ (*on hand*) + \$50 (*in bank*) + \$45 (*loans*). This equals 145, which is more than the initial 100 dollars I had. That's why there's a multiplier.

$$\$100 \rightarrow \text{banking system} \rightarrow \$145$$

3 Equilibrium the Goods Market and Financial Markets: Aggregate Demand

Since we have incorporate the financial markets into the goods market the equilibrium, we have to modify both the goods market equilibrium relation and the financial market equilibrium. First we must incorporate investment that depends on both output and the interest rate into the goods market relation:

$$Y = C(Y - T) + I(Y, i) + G + NX \quad (1)$$

Next, we have to realize that in order relate the goods market and the financial market, we have consider them in similar units. Therefore, we divide the money market equilibrium by the price level (CPI or GDP deflator).

$$\frac{M}{P} = Yf(i) \quad (2)$$

The first equation represents equilibrium in the goods market. The second equation represents equilibrium in the financial markets. When we solve for the equilibrium output as a function of $Y(\frac{M}{P}, G, T)$. If we vary output as the price level changes and graph the inverse of the curve $P(Y)$ on a $Y - P$ plane, this is what we call the **aggregate demand curve**.

$$AD : Y(\frac{M}{P}, G, T)$$

3.1 Example derivation of AD curve

Suppose $M/P = Y/i$ and that $Y = c_0 + c_1Y - c_1T + d_0 + d_1Y - d_2i + G$. We solve that:

$$i = \frac{PY}{m}$$

Substitute:

$$Y = c_0 + c_1Y - c_1T + d_0 + d_1Y - d_2\frac{PY}{M} + G$$

Solve for output:

$$AD : Y = \frac{1}{1 - c_1 - d_1 + d_2P/M}(c_0 - c_1T + d_0 + G)$$

3.2 Aggregate Demand

Aggregate demand is the quantity of output that consumers demand at a given price level. Like most demand curves, we think it's downward sloping. It's downward sloping because several "effects".

- The Wealth Effect: Nominal value of money is fixed in your bank account, the real value of the money varies. When prices fall these dollars allow you to buy more, giving you more purchasing power. Therefore, a decrease in the price level increases consumer wealth which encourages them to spend more money. The increase in consumer spending means a larger output. (Relate this with the mathematical derivation of the AD curve above).
- The Interest-Rate effect: real money demand $Yf(i)$ depends on price level in the money market equilibrium. When price level falls, people will try to reduce the amount of money they have. As people try to reduce their holdings of money, they drive down interest rates (recall that interest rate is the price of money). Lower interest rates encourage investment which in turn increases output.

3.3 Shifts in AD

- Increase in money supply (open market operations). An increase in money supply drives down interest rates which in turn increases output at every price level due to increases in investment. It shifts the AD curve to the right.
- Increase in government spending. An increase in government spending increases output at every price level, shifting AD right.
- Increase in taxes. An increase in taxes decreases consumption at every price level, causing AD to shift to the left.

4 Equilibrium in Resource Markets (Labor and otherwise): Aggregate Supply

The aggregate supply is the level of output that producers are willing to produce at a given price level. The inverse aggregate supply relation is given by:

$$AS : P(P^e, m, z, A, Y) = (1 + m)P^e f(u(Y), z)/A$$

The price level depends upon the expected price level, the mark up, output/income, technology (A) and other factors like benefits, natural resources (z). The aggregate supply assumes equilibrium in the labor market and any change in one of these variables is through the price determination or the wage determination equations:

$$P = (1 + m)W/A$$
$$W = P^e f(u(Y), z)$$

4.1 Shifts in AS

- Increase expected price level. If expected price level increases, people are going to demand higher wages as a result. Due to higher wages, price level increases causing a shift left of the AS curve.
- Increase in markup. An increase in the markup increases the price level, causing AS to shift left. Intuitively, the market is less competitive and means that producer has more price making ability.

- Increase in benefits. An increase in benefits increases the wage. An increase in the wage increases the price level, causing AS to shift to the left.
- Improvement of technology. An increase in technology decreases the price level, causing AS to shift to the right.

5 AS-AD model and Medium Run Equilibrium

The aggregate supply and demand model helps us understand short and medium run fluctuations to economic output. The following characterizes the economy in the medium run:

- The natural level of output equals the output in the medium run.
- The unemployment rate equals the natural rate of unemployment in the medium run.
- The expected price level equals the price level in the medium run.

The natural level of output is defined as the level of output consistent with equilibrium in the labor market when the actual price level is equal to the expected price level. The Aggregate Supply relation is the level of output consistent with equilibrium in the labor market given each level of prices. Usually, the natural level of output or the expected price level will change as people revise expectations. To understand this let us consider both a demand side and a supply side shock to aggregate demand.

5.1 Increase in money supply

An increase in money supply will increase aggregate demand, shifting the curve to the right. Assume that $Y_0 = Y_n$ and that $P = P^e$. Due to this shift, output increases $Y' > Y_0 = Y_n$ and $P > P^e$. The medium run adjustment process is as such. Because of the increase in price level, people will revise expectations, increasing the expected price level and wage, causing AS to shift up. This causes output to go back to the natural level of output.

5.2 Increase in unemployment benefits

An increase in the unemployment benefits increases wage and also the aggregate demand curve. This causes price level to rise and output to decrease. Since price level now exceeds expected price level, people will once again expect higher prices in the future driving up wages even more causing AS to shift from AS' to AS''. We define a new natural level of output and a new expected price level.