

The Interest Rate and Related Macro Economic Variables

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Introduction

There are many variables that influence the interest rate. The understanding of the relationship between different economic indicators and the interest rate level can provide us with clues to the future direction of interest rates. This essay will describe a choice of these relationships and introduce you to some of the known macro economic theories used to determine the interest rate.

Nominal and Real Interest Rates

Definition of Nominal and Real Interest Rates

Someone who lends money wants to be compensated for the time value of money, i.e. not being able to use this money for consumption. Furthermore, the lender wants to be compensated for the risk that the purchasing power has decreased at the time of repayment of the loan. The risk described above are systematic, regulatory and inflation risk. *Systematic risk* is the risk that the borrower will not be able to make interest and amortization payments and repay the loan at maturity. It also includes the possibility that the collateral of the loan is worth less than required in order to cover the loan. *Regulatory risk* includes changes in the law and in the taxation that makes it more difficult for the creditor to collect a loan or that results in higher taxes on the repayment amount. The last risk mentioned, the *inflation risk*, is the risk that inflation has made the money of the loan less worth, i.e. that the purchasing power of the money has decreased. Inflation is not known in advance. Because of this, lenders will demand a risk premium for the uncertainty of this factor.

The interest rate that takes all these risks and the time value of money into account is the *nominal interest rate*. This rate does not correct for changes in purchasing power. The nominal interest rate is the one that is quoted in e.g. newspapers. Deducting the premium for the inflation risk, results in the *real interest rate*. The real interest rate describes the relative price between consumption today and consumption in the future. The

rate of time preference¹ is a measure that describes how “impatient” people are to spend rather than save money. If the real interest rate is higher than the rate of time preference, people tend to be more willing to defer spending. Thus, consumption is negatively related to the level of the real interest rate, whereas saving is positively related. In summary, the real interest rate depends on the compensation investors and households demand for foregoing consumption today. A low real interest rate leads to higher consumption since the incentive to save money is low and vice versa.

The exact relationship between the nominal and the real interest rate is described through the *Fisher equation*:

$$1+n = (1+r)(1+i)$$

Where n is the nominal interest rate, r is the real interest rate and i is the inflation rate.

Example 1: A bank lends 1000 SEK at 10 percent annually to a company. If the loan is repaid after a year, the company repays 1100 SEK to the bank. If the inflation has risen with more than 10%, then the real loss is the difference between the interest rate of 10 percent and the inflation rate.

Let us look at this from another perspective. Investments result in real gains. When inflation increases, i.e. the general price level goes up; the return on capital will also increase. Since this is an increase in the nominal value, one has to subtract the inflation rate. A property portfolio with a return of 10 percent when the inflation is 2 percent has a real rate of return of 8 percent.

In order to reach their monetary policy goals the central banks use the interest rate. The difficulty with interest rates is that it is the real interest rate that affects the spending in the economy. To get a good measure of the real interest rate, they have to estimate the expectations of the inflation. Especially in periods when the inflation is very high and fluctuating it is very hard to estimate the real interest rate.

Zero Nominal Interest Rates

If the real interest rate is zero, then the nominal interest rate equals the inflation rate.

Example 2: If the inflation is 2% then the nominal interest rates are also 2%. If a bank lends 1000SEK to a company

¹ Macro Economics, R.E. Hall and J.B. Taylor, p. 286

for a year, it would receive 1020SEK at the end of the year. But something that cost 1000SEK a year ago now cost 1020SEK, so the bank is not better off.

Normally, nominal interest rates are positive, otherwise people would not have an incentive to lend money. In recessions, the central bank can choose to lower the interest rates to stimulate investments and consumption. A too quick cut in the interest rates can result in a nominal interest rate approaching the inflation rate. However, at the same time the inflation tends to increase in such a situation, since the economy is spurred by the cut in interest rates.

A so called *liquidity trap*² can cause the nominal interest rate to decline to zero. In a recession, the cash holdings in banks increase, since investors expect lower returns on both physical and financial investments and thus chose to keep the money on cash accounts instead. Cash is then continued to be held, since spending and investments are expected to stay low. This behaviour makes the recession more severe and results in a liquidity trap. The problem is that the central bank cannot use any measures to stimulate the economy in such situations. If the interest rate is zero, the central bank cannot lower the rate any more. In normal times, a decrease in interest rate results in an increase in borrowing and lending, in consumption and investment, and thus stimulates the economy.

²<http://economics.about.com>

Determination of Short Term and Long Term Interest Rates

Short term interest rates are determined by the central bank of the country. The primary goal of the Swedish central bank is to keep inflation at a level around 2 percent. Other central banks have similar goals.

Long term interest rates are determined by the market. The level mirrors the expectations of the future development of the inflation and of the interest rate of the central bank. The long term interest rate consists of the expected real interest rate, inflation and a risk premium.

Long term interest rates tend to follow the *business cycle*. When a boom is expected, the expectations of higher inflation lead to higher long term interest rates. At the top of a boom when the market begins to weaken, the long interest rates are adjusted downwards. An exception of this trend is during periods of very instable inflation.

Short term interest rates on the other hand are more volatile and do not follow the business cycle as strictly. The central banks tend to keep their key interest rate at a high level even after a top of a boom, since the threat of higher inflation can persist. After a recession the interest rate of the central bank tends to stay at low levels. The reason is that the timing is very hard for the central bank. If the central bank lowers the interest rate too early, it might cause an interruption in the recovery of the economy.

The graph in diagram 1 shows the short term and long term interest rates in relation to a boom and a recession.

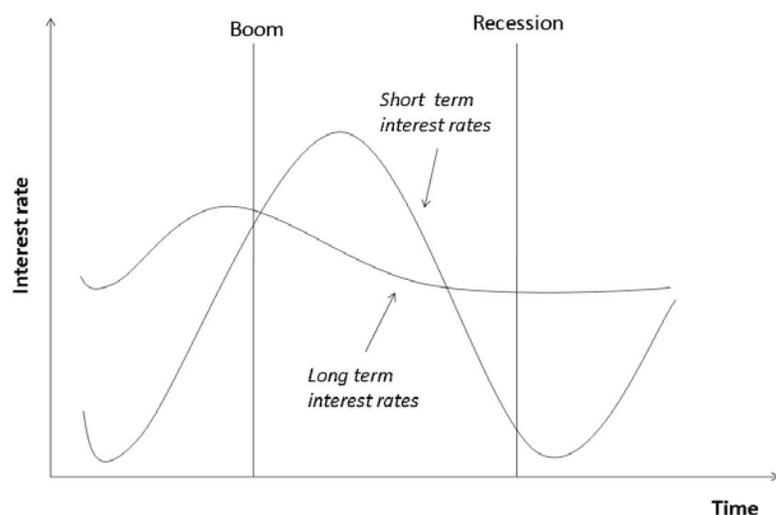


Diagram 1: The interest rate cycle

Studies from the US during the past 35 years show that real interest rates have fallen when there has been a government deficit.³ Nevertheless, this does not mean that deficits cause a decrease of interest rates, but rather that both deficits and interest rates tend to fall when there is a recession. In a recession investments and the demand for money are low. Both these factors cause the interest rates to go down.

³ Macro Economics, R.E. Hall and J.B. Taylor, p. 373

Interest Rates and the Economic Mechanism

The relation between Interest Rates and other economic indicators

Interest rates are part of the *economic mechanism*. When interest rates increase, investments, net exports and consumption tend to go down. The case is the opposite when it comes to decreasing interest rates. Why is this the case?

An increase in interest rates means that consumers, i.e. the households, have to pay more to finance their *consumption*. Many households buy durable goods on credit, such as cars and white goods. Higher required payments discourage the consumers from buying such goods, which reduces consumption. The same goes for *investments*, which can be seen as consumption by firms. Higher interest rates for financing of equipment and machinery discourage firms to do investments. In other words, when interest rates increase, investments go down, since it gets more expensive to borrow money and more tempting to save money. Thus, consumption decreases, which leads to decreased demand. This keeps the prices down and inflation decreases.

The relation between interest rates and *net exports* is less straight forward. Increasing interest rates tend to strengthen the currency of the country, since it is more appealing for foreign investors to buy that currency and invest them in that country. Thus, if a country's interest rate is high compared to foreign interest rates, capital will flow from foreign countries to this country. Such flows could be enormous if all other factors stay the same. To prevent this, the exchange rate must be strengthened as a result of the higher demand of the currency. This is called appreciation of the currency. A higher exchange rate enhances imports since foreign goods get cheaper in comparison with goods produced domestically. At the same time it reduces exports, since it makes the goods from that country more expensive to foreigners. Net export is exports minus imports. As a result of decreasing exports and increasing imports, net exports decline. Another effect of this is that the inflation is reduced through lower prices for imported goods.

Historical data shows that consumption is less sensitive to changes in interest rates than investments and net exports.⁴

⁴ Macro Economics, R.E. Hall and J.B. Taylor, p. 102

Other economic indicators than the above mentioned are also part of the economic mechanism and directly or indirectly affects the interest rate level. For example, a higher *GDP growth* than expected is considered to be inflationary, causing the central bank to raise the interest rate in order to slow down the growth. The other way round, the interest rate might be lowered to stimulate the economy when the GDP growth is negative.

Another example is the *unemployment rate*. An unemployment rate that is lower than expected or declining is considered to enhance inflation, which in turn can cause interest rates to rise. The Phillips curve⁵ shows the inverse relation between the unemployment and inflation rate, stating that the lower unemployment rate, the higher the increase in nominal wages. This relationship works well in the short term but less good in the long run.

The IS-LM Diagram⁶

The *IS curve* is a graphical approach that shows the relationship between the interest rate and GDP, or income, when the income identity⁷, the consumption function⁸ and the net export function⁹, i.e. the spending balance, is satisfied. “I” stands for investment demand and “S” stands for saving. When all relationships are satisfied, the investment demand must equal savings, i.e. income less consumption demand. As shown in the IS curve in picture 2, the higher the interest rate is, the lower the GDP. The downward slope is explained by investments and net exports being reduced when the interest rate increases. According to the income identity, GDP will fall. Keeping the interest rate constant, an increase in government spending will make the IS curve shift parallel to the right. The opposite is the case for decreased government spending.

⁵ www.wikipedia.org

⁶ Macro Economics, R.E. Hall and J.B. Taylor, p. 177-189

⁷ $\text{Income} = \text{Consumption} + \text{Investment} + \text{Government spending} + \text{Net exports}$

⁸ The consumption function describes the relationship between consumption and disposable income

⁹ The net export function describes the negative relationship between net exports and interest rates

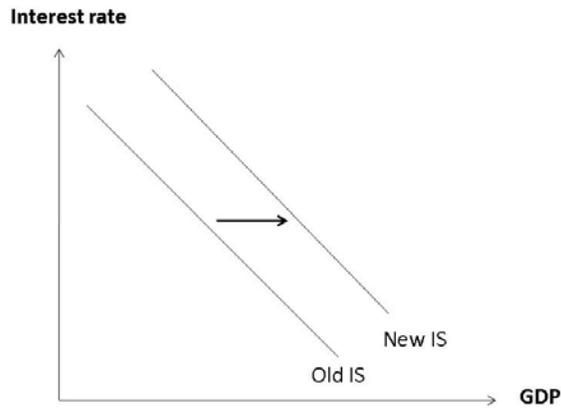


Diagram 2: The IS Curve. Increased government spending causes the IS curve to shift to the right.

The *LM curve* is another graphical approach that shows also shows the relationship between the interest rate and GDP, but when the supply of money equals the demand for money, i.e. when money market equilibrium exists. “M” stands for money supply and “L” stands liquidity preference, or money demand. The LM curve is upward sloping, i.e. that higher interest rates result in higher GDP. A rise in GDP or income increases the money demand. Since the demand for money must equal the supply of money that is fixed, the interest rate is required to go up to bring back this equilibrium. An increase in interest rates results in a decrease in money demand and thereby compensates for the increase in demand due to a higher GDP (picture 3). An increase in money supply makes the curve shift parallel to the right and vice versa. Also an increase in price level will shift the curve, but parallel to the left instead. When the price level increases, less real money is available. Decreased money supply requires either the interest rates to go up or the GDP to fall. In both cases, the curve is shifted left.

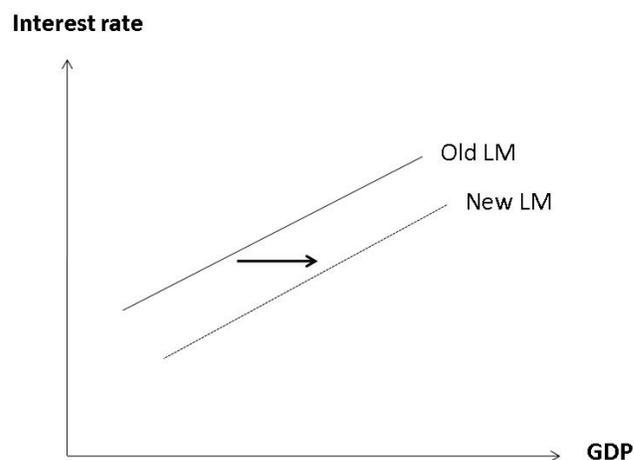


Diagram 3: The LM Curve. An increase in money supply causes the LM curve to shift to the right.

Putting the IS and the LM curves into one *IS-LM diagram*, we can find the interest rate and the GDP-level. This is shown in diagram 4. At the intersection of the two curves, we find the only combination of the interest rate and the GDP, where both the *spending balance* and the *money market equilibrium* are satisfied. This model works for the short-term, up to maybe one year, since it takes the price level as predetermined.

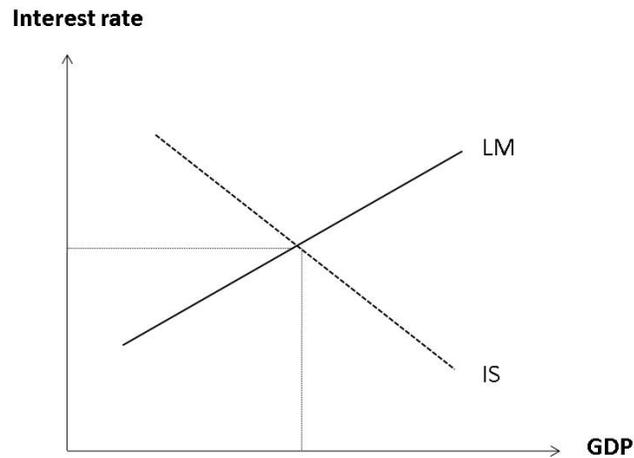


Diagram 4: The IS-LM Diagram

Central banks each set their monetary policy rule, which is a function that puts the interest rate in response to variables in the economy. This rule has to be changed sometimes due to changes in the real interest rates. If the central bank does not change it, the wrong decision might be made. If the government for example reduces its spending, the real interest rate will go down according to the IS curve, since GDP also decreases. The central bank might then set the interest rate too high, which would effect in an inflation rate below the target.

Interest Rates and the Monetary Policy

Signalling with the Key Interest Rate¹⁰

Monetary policy refers to governing the interest rate and the supply of money and credit. The central bank is the one with the main responsibility for the monetary policy of a country. As mentioned before, the most common goal is to stabilize inflation and keep it at a desired level.

The central banks all have their own *key interest rate*, which they can use to signal their intentions to the market. It is the most important tool for monetary policy.

If the central bank has monopoly on issuing money in a country, it can decide on the interest rate and conditions on the claims against the banks that are in demand of notes and coins. The central bank thus has the possibility to govern the interest rate by changing the conditions under which it is willing to enter into transactions with banks. In this way it signals its monetary policy to the market.

The Demand and Supply of Money

As shown in diagram 5, the money demand is negatively affected by the interest rate level. The interest rate reflects the return of investing in interest bearing assets, in other words the opportunity cost to having only liquid assets. Since a higher interest rate makes it more attractive to invest in interest bearing assets, the *demand of money* decreases. In contrast, a decreasing interest level results in a higher demand of money.

But how is the *supply of money* determined? Firstly, the central bank which prints bills, directly governs the quantity of money. Secondly, the commercial banks lend money to consumers and firms, that in turn will spend it on goods and services. The receivers of this money usually put the money in an account. In this way, the banks will be able to dispose of more money that they can lend. The supply of money will increase. The central bank generally set rules regarding reserves that the banks must keep in order to pay out money that the customers have deposited in the bank. Therefore the banks cannot lend all the money they dispose of. If the requirements concerning the reserves increase, the money supply will decrease as a result of the bank not being able to increase its lending. Thirdly, the central bank can affect the money supply by buying or selling treasury bills or government bonds. If the central bank buys bills

¹⁰ Interest Rates and Derivatives, Sandra Kudlacek, pp. 3-4

or bonds, it pays money to the market, which increases the supply of money. Lastly, the currency flow from and to foreign countries changes the supply of money. If the inflow is greater than the outflow, the quantity of money will increase in the country and vice versa. The higher the interest rate, relative to the rest of the world, the higher the inflow from other countries will be.

The interest rate is at equilibrium at the intersection between the supply- and demand curves. A monetary policy that increases the money supply decreases the interest rate and vice versa.

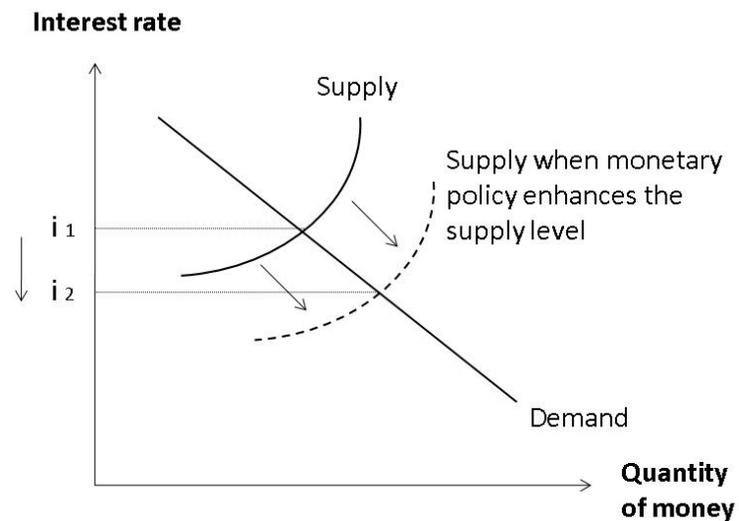


Diagram 5: The interest rate level in relation to the money supply- and demand

The Taylor Rule

The *Taylor rule* is named after John B. Taylor, an American economist who was first to propose the rule. It provided guidance for central banks how to set short term interest rates to satisfy both the goals for stabilizing the economy and the long term goal for inflation. According to the rule, a high interest rate level is recommended when the inflation is above the targeted inflation or when the economy is above its full employment level and vice versa. In the case of stagflation, these goals may conflict, i.e. the inflation is above the target level and the economy is below full employment. The central bank then has to balance these goals with the guidance of the rule.¹¹

In a podcast for EconTalk, John B. Taylor says that if the inflation rises by one percentage point the interest rate has to be

¹¹ www.wikipedia.org and www.frbsf.org

increased by more than one percentage point (he suggests 1.5 percent, but this is not an exact figure). If the GDP falls by one percentage point relative to its target, then a decrease in interest rates by less than one percentage point would be appropriate (Taylor suggests 0.5 percent).¹²

¹² www.econtalk.org

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