Video 14 - Nominal vs Real Interest: the Fisher Equation

The following is a supplementary transcript for tutorial videos from
https://blogs.ubc.ca/financefundamentals/

Welcome back everyone. Up to this point, we have been discounting our future cash flows using an interest rate that reflects our time value of money - that is, the return we require on our risk, inflation, and opportunity cost. Today, we are going to focus specifically on inflation. First, we will define inflation, and explain the difference between real and nominal interest rates; second, we will introduce the Fisher equation to explain the relationship between real, nominal, and inflation rates; and lastly, we will illustrate the importance of keeping these rates consistent when we are discounting our future cash flows. Let's get started!

Video at 00:41
So what is inflation? Inflation is an increase in the price of goods and services. It is why $1 could buy you 3 gallons of premium whiskey in 1810, and now, you would be lucky to get a sip of a Hey Y'all. Inflation can be caused by a number of factors. It is most commonly caused by an increase in the demand for goods and services, or an increase in the cost of supplying those goods and services. Both of these effects can drive up prices. For instance, if demand goes up, people will be willing to pay more, and if the cost of supply goes up, people will be forced to pay more. While inflation is a complex issue in the area of macroeconomics, as investors, we don't have to dive too deep into the complexities to understand how it affects our return.

Video at 01:22
The annual inflation rate tells us by how much prices have increased over a given year. We typically measure inflation using the Consumer Price Index, or CPI, which tracks the prices of a typical basket of goods in the market. Extreme cases of inflation can hurt the economy by causing a currency to lose much of its value. For example, during World War II, the rate of inflation was so high in Germany that people would cash their paychecks in the morning, because the bread you could buy in the morning would become unaffordable by noon. To avoid these issues, most countries adopt monetary policies to try to control inflation. The Canadian government sets an annual inflation target of 2%. For our purposes, we will take the rate of inflation as given.

Video at 02:04

So let's say inflation is 10%. If a llama costs $1,000 today, after one year it will cost $1,100 ($1,000 * 1.10). Nothing has changed about the llama - he didn't get superpowers or anything - and yet, I would have to pay an additional 10%, or $100, to buy him. What this means is that the true value of my $1,000 - that is, my purchasing power - has decreased. My $1,000 can buy me a whole llama this year, but only 91% of a llama next year. In other words, I can buy fewer goods with my $1,000 than I could have before.

Video at 02:40

As investors, we don't like inflation. Suppose I invest in a one-year bond that earns a 20% return. At the end of the year, my money has grown by 20%. So I want to be able to go out and buy 20% more things than I could have before. But if the inflation rate is 10%, my purchasing power has actually fallen by 10%. So the real return on my investment is only 9.1%, meaning that my purchasing power has only increased by 9.1%. We can express this logic as a general formula called the Fisher equation. Our real return (R) is 1 plus our nominal rate (N) divided by 1 plus our inflation rate (i):

Fisher equation: $real\ return\ =\ R\ =\frac{1+N}{1+i}$

where our real return tells us by how much our purchasing power will increase. Recall that purchasing power tells us how far our dollar can go to buy things. The nominal rate is the percent return we earn on an investment, and the inflation rate is the percent increase in the price level, like the CPI.

Video at 03:36

If you are in a hurry, the formula:

$$real\ rate \approx inflation\ rate\ +\ nominal\ rate$$

will approximate the real rate of interest (our percent increase in purchasing power), although it becomes less and less accurate as the nominal and inflation rates increase. If you have a calculator handy, it is best to just use the original formula (Fisher equation).

Video at 03:54

When evaluating an investment, you should always consider your real return. This return should fully compensate you for the remaining components of your cost of capital (your risk and opportunity cost). Unfortunately, investors often neglect real rates and instead base their decisions on nominal rates. We call this the "money illusion." What can go wrong with nominal rates? Well, let's say that you aren't overly concerned with growing your money, so you choose to invest in a low yield investment that earns 3% each year. But suppose the rate of inflation is 4%. Plugging these values into our equation, we learn that the real rate of return is actually negative!

$$real\ return\ =\ R\ =\frac{1+N}{1+i}=\ \frac{1+0.03}{1+0.04}\ = 0.9904$$

net return = 99.04% - 100% = -0.96%

You are effectively losing value each year. This is why as a smart investor, you should ensure that your investments can earn you a return that is at least as high as the rate of inflation. Otherwise, you are actually losing money. You would be better off spending your money on something today, while you have greater purchasing power. Maybe that llama you have always dreamed of?

Video at 04:50

Next, let's talk about how to deal with inflation in our present value calculations. When dealing with inflation, we have two choices: we can discount our nominal future cash flows by our nominal interest rate to calculate the present value of our investment, or we can discount our real future cash flows by the real interest rate to calculate our present value. Regardless of which rate we use to compound our cash flows, we will get the same answer for our present value, since either way we must start with the same amount of money. We only see a difference between our nominal and real cash flows over time, since they're compounded at different rates. The farther into the future this cash flow is, the greater this difference becomes, since there are more compounding periods. The key here is being consistent. We should express all of our cash flows and discount rates in either nominal or real terms, so that we can compare apples to apples, the same way you'd convert cash flows into the same currency before adding or comparing them.

Video at 05:46

Let's try an example using these two different methods: discounting nominal returns and discounting real returns. Pause the video and try this problem on your own.

You recently befriended a baby raccoon, Rocky. You have decided that, for his 5th birthday, you would like to buy him one of those hamster cages with all the tunnels and stuff, except for *raccoons. The current price of this raccoon playhouse is $4,000, and is expected to increase by 2% per year. If you can earn a nominal return of 7% per year in a mutual fund, how much must you invest today to buy the playhouse on Rocky's 5th birthday?*

Let's try it together. First, we will solve for our present value using nominal cash flows. We need to figure out how much the play house is going to cost in five years. Prices are rising at 2% each year. This is our inflation rate. Thus, in 5 years, the playhouse will cost

$$cost_t = price_0 \times (1+i)^t = \$4,000 \times (1.02)^5 = \$4,416.32$$

Next, we need to discount this nominal future value by 7% for five years to determine how much we should invest today. We will take

$$PV_0 = \frac{\$4,416.32}{(1.07)^5} = \$3,149$$

If we invest $3,149 today at 7%, we will have enough money to buy this playhouse in five years.

Video at 06:47

Now, let's compare by solving for the present value using real cash flows. First, we will calculate the real rate of return. We can earn 7% each year, but inflation is 2% each year; thus, our real return is

$$real\ return = R = \frac{1+N}{1+i} = \frac{1+0.07}{1+0.02} = 4.9\%$$

Now, let's discount the price of the playhouse ($4,000 in today's terms) by the real rate (4.9%) for the five years:

$$PV_0 = \frac{\$4,000}{(1.049)^5} = \$3,149$$

which is the same answer as what we had above when solving using nominal cash flows.

Video at 07:21

The important rule to remember is to always discount nominal cash flows to their present values using the nominal interest rate, and real cash flows to their present value using the real interest rate. Unless otherwise stated, you can assume that cash flows and interest rates are in nominal terms. Once cash flows are expressed in present value, you can compare and combine them.

Video at 07:41

Today, we talked about how inflation results in our real returns being lower than our nominal returns. We can use the Fisher equation to solve for our real return by dividing our nominal rate by the inflation rate. Lastly, when doing time value calculations, remember to always discount nominal cash flows by the nominal interest rate and real cash flows by the real interest rate. Thanks for watching!