Inflation: Economic Analysis

1. Economic Analysis Including Inflation
Our tools of economic evaluation and comparison must be modified to explicitly include the effects of inflation. This lecture shows how.

2. This Lecture
- Construct a cash flow based on estimates.
- Change the estimated cash flow to an actual cash flow.
- Change an actual cash flow to a real cash flow.
- Compute the NPW with either actual or real cash flows.
- Compute NAW and ROR considering inflation.
These are the steps of the analysis process that are discussed in this lecture. Not all applications use every step.

3. Economic Analysis
- Estimate the several cash flow components using current data concerning costs and revenues.
- Escalate the costs and revenues using the escalation rates for each component. This results in a cash flow in actual dollars.
- For an analysis with real dollars use the general inflation rate to deflate the actual cash flow to a real cash flow.
I want to emphasize that there are three kinds of cash flows. The first evaluates the various cash flow components with the prices that we would pay if they were bought today. These prices might come from current catalogs or current experience.

Second, use escalation rates to estimate future expenditures and receipts. Escalation rates are like inflation rates but they can differ between the components of the cash flow. Electricity might escalate at a different rate than labor for instance. When prices are escalated the cash flow is in actual dollars. The analysis can proceed with the actual dollar cash flow or change it to real dollars.

To change the actual dollar cash flow to a real dollar cash flow, deflate the amount in each period using the general inflation rate.

The first step is estimation. Here the estimator does not worry about inflation, but estimates future costs and revenues using today’s prices. The estimated cash flow is a series of receipts and expenditures over time. We use $E_n$ as the estimated value at time $n$. 
5. **Escalate Estimates to Actual Dollars**
   Now, escalate the estimates to actual dollars. The example shows only a single escalation rate indicated by a lower case e, but most situations will have several components with different escalation rates.
   The amount of the cash flow at the general time n is multiplied by a growth factor with n in the exponent. We have not moved the amount in time; we have changed the measure of the amount into actual dollars. We describe the actual amount at time n as $D_n$. Since escalation rates are usually positive the actual dollar cash flow is larger than the estimated cash flow.

6. **Change Actual to Real Dollars**
   It may be that we would prefer to express the cash flow in real dollars. To do this, we deflate each actual dollar amount to a real dollar amount using the general inflation rate. The general inflation rate is the lower case f. With inflation, the real dollar cash flow is less than the actual dollar cash flow. Again, we have not changed the timing of the amounts we have changed the dimension of measurement.

7. **Present Worth Analysis**
   Our goal in all this is to perform an economic analysis to accept or reject the cash flow. We have two kinds of cash flows and two kinds of the minimum acceptable rates of return. The right combinations give us two ways to do the analysis. With the cash flow expressed in actual dollars use the Market MARR to find the NPW. With the cash flow expressed in real dollars use the Real MARR to find the NPW. Both give the same value. This is an important result.

8. **Which MARR to Use?**
   Use the real MARR to compute the NPW of real cash flows.
   Use the market MARR to compute the NPW of actual cash flows.
   Both yield the same NPW.
   Use the one that is easiest.

   To recap, there are two ways to find the NPW when inflation is considered. Use the real MARR with real dollar cash flows. Use the Market MARR with actual dollar cash flow. The results will be the same. In any given instance, use the one that is easiest to do or to understand.
9. **Example**

**Escalation=Inflation**

The investment is $10,000 and the life is ten years with no salvage.

Based on today’s prices, we estimate operating costs at $500 per year, and revenues at $2000 per year.

All costs and revenues are fully responsive to inflation. That means the escalation rates are the same as general inflation.

We use this example for different assumptions about inflation. The $10,000 investment results in revenue for 10 years at $2000 a year and ten years of operating costs at $500 a year. The values of revenue and operating cost are estimated based on today’s prices.

For the first case we say that both factors are fully responsive to inflation. That means, they grow at the same rate as general inflation.

10. **The MARR**

The real MARR (without inflation) is 4%.

The general inflation rate is 5%.

Therefore, the market MARR (with inflation) is:

The company’s real minimum rate of return is 4%. This is the rate that an acceptable investment would earn if there were no inflation. We estimate the average annual general inflation rate for the next ten years to be 5%. We compute the market MARR with the formula given earlier. Including inflation, the MARR for the company is 9.2%.

11. **Analysis**

The tables show the two analyses. The real value analysis is at the left. Since the two cash flows escalate at the same rate as general inflation, the future cash flows have the same real values as the cash flows estimated in today’s prices. The net value of revenue minus cost is $1500. The column labeled PW shows the present worth of the amount at each time. A real dollar analysis requires that we use the real MARR, 4%, to compute the present worth. The sum of the ten values is the net present worth of the project, $2166.

The actual dollar analysis is at the right. The column labeled actual shows the $1500 estimated in today’s prices escalated by the rate 5%. The values are the actual dollar profits for the next ten years. The column labeled PW finds the present worth values computed with the market rate, 9.2%. Since the NPW is positive, this is an acceptable investment.

The example illustrates the important point that the NPW values computed with the two methods are the same.
12. Neglecting Inflation

Sometimes inflation can be neglected

For an economic analysis, if all receipts and expenses expand at the same rate as the general inflation rate, forget about inflation.

Do the analysis with real dollars and the real MARR.

The example also illustrates another important point. Sometimes inflation can be neglected. When all receipts and expenses expand at the same rate as general inflation, the cash flow based on today’s prices and the real dollar cash flow are the same. You can do the analysis based on today’s prices, but you must use the real MARR.

13. Example

Escalation ≠ Inflation

The investment is $10,000 and the life is ten years with no salvage. Based on today’s prices, we estimate that operating costs as $500 per year and revenues at $2000 per year.

Operating costs escalate at the same rate as general inflation. Revenues do not increase with time.

The real MARR is 4% and the general inflation rate is 5%.

To illustrate a different case we use the same example, but change the assumptions regarding escalation. Operating costs increase at the same rate as general inflation, but for some reason revenues are fixed at $2000. That means that revenue will be $2000 in each year measured in actual dollars.

14. Different Inflation Rates

If some components of receipts and disbursements do not have the same escalation rate either:

Express all cash flows in actual (year-n) dollars and use the market MARR.

Express all cash flows in real (year-0) dollars and use the real MARR.

In this mixed case we have two choices. Express the cash flow in actual dollars and use the market MARR, or express the cash flow in real dollars and use the real MARR.

15. Actual Dollars

The table shows the actual dollar analysis. The costs are increasing because they are growing with the 5% inflation rate. The revenues are fixed in actual dollars. The net cash flow is the difference between revenues and cost and it is decreasing because of the increasing costs. The final column computes the present worth of each amount. Since the cash flow is in actual dollars we use 9.2%, the market MARR, to compute the net present worth. The NPW value is negative $1332, indicating that the project does not return the minimum acceptable rate of return. Inflation makes a difference.
16.  

Real Dollars  
The analysis can be performed in real dollars. Measured in real dollars the costs are constant, but the revenues are decreasing. The net cash flow is the difference between revenue and cost. Since these are real dollar values, the present worth is computed with the real MARR of 4%. It should not be surprising that the NPW is the same as computed with the actual dollar analysis. This will always be true.

17.  

Net Annual Worth  
Because we have two kinds of the MARR, there are two options for computing the net annual worth. Both use the A/P factor but with different rates. The market rate gives a NAW that is uniform in actual dollars. This is how installment loan payments are computed. 
Using the real rate returns the value of a uniform series that is constant in real dollars. This is the best choice for evaluating investment alternatives.

18.  

Rate of Return  
If you compute the rate of return based on a cash flow in actual dollars, the rate includes the general inflation rate. We could compare this to the market MARR to evaluate the cash flow. 
If the rate is computed based on a cash flow in real dollars, the rate does not include an adjustment for inflation. Compare it to the real MARR.

19.  

Summary  
When all cash flow components escalate at the general inflation rate, the estimated cash flow is the same as the real cash flow. Find the NPW with the estimated cash flow and the real MARR.
When some cash flow components escalate at different rates than the general inflation rate, either use real dollars and the real MARR or actual dollars and the market MARR.
Analysis with inflation deals with three cash flows. The first estimates the amounts of the cash flow based on today’s prices. We call this the estimated cash flow. Escalating the cash flow components we obtain the actual dollar cash flow. These are the amounts we actually expect to pay measured in dollars of the future. We can deflate this cash flow using the general inflation rate to obtain the real dollar cash flow.
The first bullet of the summary says that all this is unnecessary if you think that the cash flow components escalate at the same rate as general inflation. Then use the estimated cash flow and the real MARR to make a decision. It is important that you use the real MARR for the analysis.
If different components escalate at different rates then there are two alternatives. Evaluate the actual dollar cash flow with the market MARR or evaluate the real dollar cash flow with real MARR.
Neglecting inflation, as in the first choice, is the easiest route for calculations, but if inflation is an issue now you know the proper way to deal with it.