Lecture 14: Inflation

Inflation has been described as the situation that occurs `when nobody has enough money because everybody has too much.' It may more usefully be defined as the rate at which the purchasing power of money declines over time. For this to make any sense, we need some measure of the purchasing power of money, distinct from its face value. We can, for example, consider the weight of grain that can be purchased per dollar, or the number of floating-point operations that can be performed per dollar, or the number of hours of human labour that can be purchased per dollar.

Each of these measures will give different values for inflation; for example, a dollar will buy less wheat and fewer hours of labour than it did ten years ago, but it will buy many more floating-point operations.

Statistics Canada measures inflation by calculating the purchase price of a standard set of items, chosen to represent the consumption patterns of a middle-class Canadian family. This yields an index, known as the Consumer Price Index, or CPI. A second index, the *Industry Selling Price Index*, measures inflation in the wholesale price of goods, and a third, the *Implicit Price Index*, measures inflation in the cost of goods and services.

By any of these measures, the purchasing power of money has declined monotonically since 1953 (when there was a brief period of deflation). The rate of inflation has varied over time; in the US and Canada, the inflation rate was less than 2% per annum between 1953 and 1965, but it rose to almost 9% during the decade 1973-1982. Currently it is about 3%. (The monotonic decline in the value of money is not a law of nature, or even a law of economics. Last century, for example, the value of money increased more than it fell.)

Some other countries have experienced much higher inflation rates; for example, the Weimar Republic in the early 1920's suffered inflation at a rate much greater than 100% (largely due to the strain on the German economy resulting from the war debts imposed on it by the victors of World War 1.) Hungary, in 1946, experienced inflation at such a rate that banks issued certificates for 1 octillion pengoes (10^{27} pengoes). Israel, during the Eighties, experienced an inflation rate of about 150% per year; more recently, the former USSR has experienced inflation at 1000% per year. In 1992, Zaire's currency inflated by 7000%.

This phenomenon, *hyperinflation*, is an example of positive feedback: if the inflation rate rises, holding cash becomes less attractive, so people rush to exchange it for goods. This increases the demand for goods, and hence their price goes up, exacerbating the inflation.

The *causes* of inflation are part of the subject matter of macroeconomics, and hence beyond the scope of this course. We note that governments can easily produce inflation by printing money at a rate greater than the underlying growth rate of the economy, but this is not the only possible cause; for example, there was massive inflation in sixteenth-century Europe, which used gold-based currencies, due to the influx of gold and silver from mines in South America. We do need to discuss the *effects* of inflation.

For business planning, inflation rates at their current level of a few percent can safely be ignored. However, we should be prepared to deal with higher rates, since we may experience them in the future, or in doing business in other parts of the world.

To discuss the effect of inflation, we need to distinguish between `actual dollars' and `constant dollars'. We first establish a reference point in time -- January 1, 1998, say. At the reference point, by definition, one actual dollar is worth one constant dollar. At any later period in time, an actual dollar is the worth of a loonie, while a constant dollar is the amount of money it would cost to buy a basket of goods which could be bought

for a dollar on January 1, 1998.

There are two possible strategies for doing economic calculations in the presence of inflation: we can convert all cash flows into constant dollars, or we can calculate using actual dollars. In the latter case, we can increase the MARR by the inflation rate to give a fair comparison.

For a pre-tax analysis, both methods give the same results. For an after-tax analysis, the latter method should be used, since the tax deductions allowed for depreciation and loan repayment are not affected by inflation.

The MARR we should use in actual-dollar-based calculations is known as the *adjusted*, *inflated* or *nominal* rate of return. (The last name, `nominal', is particularly unfortunate, because of the potential for confusion with the `effective' and `nominal' interest rates discussed in the first week of classes. In what follows, we will always call the adjusted MARR the `adjusted MARR', and denote it by $MARR^*$.) The adjusted MARR is related to the real MARR by

$$MARR^*=(1+MARR)(1+f)-1$$

where f is the rate of inflation. Thus, in general, we expect $MARR^*$ to be greater than MARR.

After-Tax Studies with Adjustment for Inflation

After-tax studies should be done using actual dollars. The present worth of a proposal is usually reduced by the inclusion of inflation, since the taxes saved by the depreciation allowance do not increase in proportion to inflation, but the project costs do.

Differential Inflation

Careful analysis is needed for situtations in which the inflation rate varies for different goods. This may occur when company expenditures vary at one inflation rate, while company receipts vary at a different rate. It is also possible that different strategies under consideration may be affected by inflation in different ways. A particular example of this is the choice between buying and leasing a piece of equipment.

Examples

Before-Tax Analysis

An asset with a six-year life can be purchased for $120,000. It costs $12,000/year to operate, and generates a revenue of $40,000/year (both these costs assume no inflation.) If the real MARR is 15% and the inflation rate is 8%, what is the pre-tax worth of the purchase?

Real-Dollar Analysis

The real-dollar cash flows aren't affected by inflation, so the calculation is just

$$PW = - 120,000 + 28,000(P/A,15,6) = -14,037$$

Actual Dollar Analysis

Year	Real Cash Flow	Inflation Factor	Actual Cash Flow	$(P/F,i_f,N)$	PW
0	-120,000	1	-120,000	1	-120,000
1	28,000	1.08	30,240	0.8052	24,348
2	28,000	1.1664	32,659	0.6482	21,172
3	28,000	1.2597	35,272	0.5220	18,410
4	28,000	1.3604	38,091	0.4202	16,007
5	28,000	1.4693	41,141	0.3384	13,921
6	28,000	1.5868	44,430	0.2724	12,105

Total					-14,037

We see that for a pre-tax analysis, working in real dollars is quicker and simpler than working in actual dollars. But when we come to after-tax analysis, we will find it better to work in actual dollars:

After-Tax Analysis

An asset with a six-year life can be purchased for $120,000. It costs $12,000/year to operate, and generates a revenue of $40,000/year (both these estimates assume no inflation.) If the real MARR is 15% and the inflation rate is 8%, what is the after-tax viability of the purchase?

(1) Time	(2) BCTF (Actual)	(3) CCA	(4) Taxable Income	(5) Taxes	(6) ATCF (A)	(7) Deflation	(8) ATCF (R)	(9) Discount	(10) PW
0	-120,000				-120,000		-120,000		-120,000
1	30,240	12,000	18,240	7,296	22,944	0.92593	21,245	0.86957	18,474
2	32,240	21,600	10,640	4,256	27,984	0.85733	23,992	0.75614	18,141
3	35,272	17,280	17,992	7,197	28,075	0.79383	22,287	0.65752	14,654
4	38,091	13,824	24,267	9,707	28,384	0.73503	20,863	0.57175	11,928
5	41,141	11,059	30,082	12,033	29,108	0.68059	19,811	0.49718	9,849
6	44,430	8,847	35,583	14,233	30,197	0.63017	19,029	0.42322	8,227
7 to Eternity									1,068
Total									-37,658

Notes:

- Column 2 gives the before-tax cashflow in actual dollars.
- Column 3 gives the capital cost allowance resulting from depreciation of the balance in this asset class.
- Column 4 is Column 2 less Column 3.
- Column 5 is 0.4 (the tax rate) multiplied by Column 4 -- this gives the total taxes paid in the given year.
- Column 6 is the after-tax cashflow in actual dollars, obtained by subtracting taxes (col. 5) from pre-tax cashflow (col. 2).
- Column 7 is the deflation factor, used to turn actual dollars into real dollars.

- Column 8 is the after-tax cashflow in real dollars (Col. 6 times Col. 7).
- Column 9 is the discount factor, used to move the real dollars back through time to the present.
- Column 10 is the present worth of the cashflow for the year.

The `Year 7 to Eternity' row in the table represents the remaining tax relief from the balance in the asset class. It can be calculated as (Amount in the asset class at the end of Year 6) * CCTF, where the CCTF is based on the inflated interest rate, i_f)

Example 2

A comnpany is deciding whether to buy or to rent a Plebney machine. It costs $100,000 to buy, and $40,000/year to rent. The company will need the machine for another three years; after three years, the machine has a salvage value of $20,0000. The company has a pre-tax MARR 0f 10%, and lease charges are paid on Dec 31.

Case 1: No Tax, No Inflation

In this, simplest case, the present worth of buying is:

PW = -100,000+20,000(P/F,0.1,3)= -$84,974

and the present worth of leasing is:

PW=-40,0000(P/A,0.1,3)=-$99,480

This suggests that buying is the better option.

Case 2: Tax but No Inflation

The company pays tax at 50%, and the machine is in Asset Class 8, which depreciates at 20% per year. The present worth of leasing is now:

PW=$40,000(1-0.5)(P/A,0.1,3) = $49,740

To find the present worth of buying, we do an analysis in terms of actual dollars:

(1) Year	(2) BCTF (Actual)	(3) Asset Class	(4) CCA	(5) Tax Saving	(6) PW
0	-100,000				-100,000
1		50,000	10,000	5,000	4,545
2		90,000	18,000	9,000	7,438
3	20,000	52,000	10,400	5,200	18,932

4 to Eternity		41,600		15,142	10,324
Total					-58,761

Notes:

1. In column 3, we calculate the total amount in the Asset class for this machine, using the post-1982 rule.
2. In Year 3, we add two contributions to the present worth: the tax saving from depreciation in Year 3, plus the present value of the $20,000 received for salvage.
3. After Year 3, there is still some money in the asset class, so we multiply the remaining total by (1-CCTF) to get the value (in Year 3) of depreciating that balance from here to eternity. Then we multiply by (P/F,i,3) to move it back to the present.

We note that the attractiveness of leasing increases in an after-tax analysis, since we are paying lease costs with 50-cent dollars, while we're paying purchase costs with CCTF-cent dollars.

Case 3: Tax and Inflation

We now make the additional assumption that inflation is occurring at 20% per year.

Our analysis of the `leasing' option now depends on whether we consider the lease cost to be fixed by contract or to rise with inflation. If it's fixed by contract, then the present worth of this option is

$$PW=40,000(1-0.5)(P/A,i_f,3)=\$34,600$$

where i_f is the `inflated interest rate', obtained from

$$i_f=(i+1)(f+1)-1$$

If, on the other hand, the lease cost inflates with the inflation rate, then the present worth of this option will be $49,740, as before.

Our analysis of the `buying' option is now as follows:

(1) Year	(2) BCTF (Actual)	(3) Asset Class	(4) CCA	(5) Tax Saving	(6) PW
0	-100,000				-100,000
1		50,000	10,000	5,000	3,788
2		90,000	18,000	9,000	5,165
3	20,000	52,000	10,400	5,200	10,956

4 to Eternity		41,600		7,030	3,057
Total					-77,034

Notes:

1. In column 3, we calculate the total amount in the Asset class for this machine, using the post-1982 rule.
2. In going from Column 5 to Column 6, we depreciate and deflate simultaneously, using the inflated interest rate

   $i_f=(1+i)(1+f)-1=0.32$

3. In Year 3, we add two contributions to the present worth: the tax saving from depreciation in Year 3, plus the present value of the $20,000 received for salvage. We are assuming that the $20,000 quoted for salvage value was in actual dollars.
4. After Year 3, there is still some money in the asset class, so we multiply the remaining total by (1-CCTF) to get the value (in Year 3) of depreciating that balance from here to eternity. The CCTF we use is based on the inflated interest rate Then we multiply by $(P/F,i_f,3)$ to move it back to the present.

Note that adding inflation to the picture makes leasing look still better compared with purchase.

When you tackle exam or assignment questions, it's essential to know what figures are given in actual dollars and which are in real dollars. If the question seems ambiguous, assume one or the other, and state your assumption clearly in your answer.

John Jones
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