



## Technical Training in Project Appraisal for the Lower Mekong Basin

INTEGRATED ANALYSIS OF PROJECTS  
Real price changes, inflation and exchange rates

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# Expected inflation and cash flow construction

- Real Value (NPV) of an investment project is changed by level (and variance) of future expected inflation
  - Inflation is a real tax on nominally denominated assets such as receivables (debtors) and cash balances; real income taxes are also affected by inflation
- General price inflation is average change in all prices in domestic economy
- Real or relative price changes occur when prices of specific item grow faster or slower than general price inflation: Example
  - Expected general price inflation is 10%
  - Wage rates expected to grow at 12%
  - Real wage rate increase is (approximately) 2%

# Expected inflation and interest rate

- Recommended that all cash flow items be adjusted by
  - Expected inflation over the future period PLUS
  - Separate adjustment for any change in real prices of specific revenue or expenditure items
- Thus price next year  $P_{t+1} = P_t * (1 + \text{real increase}) * (1 + \text{inflation})$
- Interest rates and discount rates need to be adjusted in a similar fashion to have consistency in appraisal of investment project. Nominal interest rate is composed of:
  - Nominal Interest Rate =  $i$ 
    - Real Interest Rate =  $r$
    - Risk Premium =  $R$
    - Expected growth (inflation) in prices =  $gP^e$
  - nominal interest rate is then  $i = r + R + (1 + R + r) gP^e$

# Inflation and exchange rate

- **Exchange rate (D\$/F\$) is market price of foreign dollar:**

It needs to be projected in similar and consistent fashion with the inflation rate of general prices in order to construct cash flows for foreign currency receipts or disbursements – export sales, import costs and foreign currency loans.

- The exchange rate will devalue in line with the differential in the rates of general price inflation in the domestic and foreign currencies: known as **maintenance of purchasing power parity (PPP)**.

- If for example, Dong vs. Dollar rate is 25,000 and inflation in Vietnam is 10%, next year purchasing power of dong would be lower and the foreigner will ask for 2,500 dongs more so that exchange rate would be 27,500. If US has 2% inflation rate, then purchasing power would go down by  $25000 \times (1.1/1.02)$  or by approximately 1960 dongs.

# Market Exchange Rates and Inflation

The market exchange rate is the current price of foreign exchange.

The market rate between the domestic currency (D) and the foreign currency (F) can be expressed at any point in time (t) as:

$$E^M_t = (\#D/F)_t$$

Next Year, if domestic inflation is  $gp^D$ , number of domestic currency required to buy a foreign dollar will be  $D(1+gp^D)/F$ . If the foreign country also has inflation  $gp^F$ , this number will be  $D(1+gp^D)/F(1+gp^F)$ . Thus the exchange rate next year will be

$$E^M_{t+1} = D(1+gp^D)/F(1+gp^F) = E (1+gp^D)/(1+gp^F)$$

For subsequent years, the same formula will be extended.

# How Inflation Affects Financial Analysis

## 1. Direct Impacts

- a. On Financing of Investments
- b. On Real Desired Cash Balances
- c. On Real Acts Receivable and Acts Payable
- d. On Nominal Interest Expenses Paid

## 2. Tax Impacts

- e. Interest Expenses Deductions
- f. Depreciation Expenses
- g. Inventories and Cost of Goods Sold

# Direct Impacts of Inflation

## (a) Financing of Investment

- Cost Escalation Due to Inflation

*vs.*

- This will be in addition to the cost overrun of Real Expenditures
- Planning for Cost Escalation Due to Inflation is Normal and Should be Part of Financing Plan

## (b) Inflation and Desired Cash Balances

### Case A: Desired cash balance With Zero Inflation

#### Assumptions

- Zero Inflation
- Desired cash = 10% of Annual Sales
- Real rate of discount = 5%

Year	0	1	2	3	4
Sales	2000	2000	2000	2000	0
Desired Cash	200	200	200	200	-
Cash Flow Impact	-200	0	0	0	+200

$$\text{Real PV of Holding Cash} = -200 + 200/(1+.05)^4 = -35.46$$



## (b) Inflation and Desired Cash Balances

### Case B: Desired cash balance With 20% inflation

#### Assumptions

- 20% Inflation
- Desired cash = 10% of Sales
- Real rate of discount = 5%

Year	0	1	2	3	4
<b>Price Index</b>	<b>1</b>	<b>1.2</b>	<b>1.44</b>	<b>1.728</b>	<b>2.074</b>
Sales	2000	2400	2880	3456	0
Desired Cash	200	240	288	345.6	0
Cash Flow Impact	-200	-40	-48	-57.6	+346
Real Cash Flow	-200	-33	-33	-33	167

PV@ 5% = -153.66

With inflation rate of 20% the cost of cash balances have increased 4.33 times

## (c) Impact of Inflation on Accounts Receivable and Accounts Payable

### Case A: Accounts receivable with Zero Inflation

Assumptions

- Zero Inflation
- Acts Receivable = 50% of Sales

Year	0	1	2	3	4
Sales	2000	2000	2000	2000	0
Acts Receivable	1000	1000	1000	1000	0
Change /AR	-1000	0	0	0	+1000
Receipts	1000	2000	2000	2000	+1000

## (c) Impact of Inflation on Accounts Receivable and Accounts Payable

### Case B: Accounts receivable With 20% inflation

#### Assumptions

- 20% Inflation
- Acts Receivable = 50% of Sales

Year	0	1	2	3	4
Price Index	1	1.2	1.44	1.728	2.074
Sales	2000	2400	2880	3456	0
Acts Receivable	1000	1200	1440	1728	0
Change /AR	-1000	-200	-240	-288	+1728
Receipts	1000	2200	2640	3168	1728
A. Real Receipts if 20% inflation	1000	1833	1833	1833	833
B. Real Receipts if zero inflation	1000	2000	2000	2000	+1000
Difference (A-B)	0	-167	-167	-167	-167

## (d) Interest Expense

- Nominal Interest Rate = (i)
- Real Interest Rate = (r)
- Risk Premium = R
- Expected Growth (inflation) in Prices =  $gP^e$

Given the factors above, nominal interest rate is calculated as:  $i = r + R + (1 + R + r) gP^e$

With 5% r, no risk premium and 20%  $gP^e$  nominal interest rate will be  $1.05 * 1.2 - 1 = 1.26$

## Inflation and Its Effect on Interest and Principal Payments

	Period				
	0	1	2	3	4
<b>1. \$1000 Loan @5% Interest &amp; No Inflation</b>					
Loan	-1000				
Interest		50	50	50	50
Loan Payment					1000
Cash Flow in Year 0 Prices	-1000	50	50	50	1050
Discounted Cash Flow @ 5%	-1000	47.62	45.35	43.19	863.84
Net Present Value	0				
<b>2. \$1000 Loan @5% Interest &amp; 20% Inflation</b>					
Loan	-1000				
Interest		50	50	50	50
Loan Payment					1000
Cash Flow in Current Prices	-1000	50	50	50	1050
Cash Flow in year 0 Prices	-1000	41.67	34.72	28.94	506.37
Discounted Cash Flow (5%)	-1000	39.68	31.49	25.00	416.59
Net Present Value	-487.24				
<b>3. \$1000 Loan @ 26.0% Interest &amp; 20% Inflation</b>					
Loan	-1000				
Interest		260	260	260	260
Loan Payment					1000
Cash Flow in Current Prices	-1000	260	260	260	1260
Cash Flow in year 0 Prices	-1000	216.67	180.56	150.46	607.64
Discounted Cash Flow (5%)	-1000	206.35	163.77	129.98	499.91
Net Present Value	0				
<b>4. Undiscounted Change in Cash Flow</b>					
Case 1 - Case 3 in Year 0 Prices	0	-166.67	-130.56	-100.46	+442.36

## (2) Tax Impacts of Inflation

### (e) Tax Deduction of Interest Expense

Tax shelter of interest expense because it is a deduction from taxable income

Case A: If 5% interest rate, \$1000 loan, and zero inflation then

Year	0	1	2	3	4
Interest Expense		50	50	50	50
A: If $t_c = 40\%$ , Tax savings		20	20	20	20

Case B: If 20% inflation, 26.0% interest, \$1000 loan then:

Year	0	1	2	3	4
Nominal Interest Expense		260	260	260	260
Real Interest Expense		216.67	180.56	150.46	125.39
B: If $t_c = 40\%$ , Tax Savings		86.67	72.22	60.19	50.15
Increased Tax Shelter (B-A)		66.67	52.22	40.19	30.15

## (f) Inflation Depreciation Expense and Taxes

Investment of \$1000 in year zero, depreciated over 4 years, depreciation expense is deductible from taxable income

Year	0	1	2	3	4
Depreciation		250	250	250	250
Tax Savings if $t_c = .40$		100	100	100	100
A: If zero inflation, real value of tax savings		100	100	100	100
Price Index if 20% inflation	1	1.20	1.44	1.73	2.07
B: If 20% inflation then real value of savings		83.33	69.44	57.80	48.31
Real difference in tax savings (A-B)		16.67	30.56	42.20	51.69

## (g) Inflation, Inventories and Cost of Good Sold

Two ways of accounting for cost of goods sold or inventory valuation:

(1) FIFO(2) LIFO

### 1. First-in-first out (FIFO) method of inventory valuation: If Zero Inflation

Year	0	1	2	3
A. Sales of Output	0	300	300	300
B. Purchases of Input	100	100	100	0
C. COGS		100	100	100
D. Measured Profits (A-C)		200	200	200
E. Taxes Paid if $t_c = .40$		80	80	80
<b>If 20% Inflation</b>	<b>Price Index</b>	<b>1.2</b>	<b>1.44</b>	<b>1.728</b>
a. Sales	0	360	432	518.4
b. Purchases of Input	100	120	144	0
c. COGS		100	120	144
d. Measured Profits		260	312	374.4
e. Nominal Taxes Paid if $t_c = .40$		104	124.8	149.76
f. If Real Taxes Paid		86.67	86.67	86.67
Difference f-E		6.67	6.67	6.67



## (g) Inflation, Inventories and Cost of Good Sold

### 2. Last-in-first-out (LIFO) method of inventory valuation: If Zero Inflation

Year	0	1	2	3
A. Sales of Output	0	300	300	300
B. Purchases of Input	100	100	100	0
C. COGS		100	100	100
D. Measured Profits (A-C)		200	200	200
E. Taxes Paid if $t_c = .40$		80	80	80
<b>If 20% Inflation</b>	<b>Price Index</b>	<b>1.2</b>	<b>1.44</b>	<b>1.728</b>
a. Sales	0	360	432	518.4
b. Purchases of Input	100	120	144	0
c. COGS		120	144	100
d. Measured Profits		240	288	418.4
e. Nominal Taxes Paid if $t_c = .40$		96	115.2	167.36
f. If Real Taxes Paid		80	80	96.85
Difference f-E		0	0	16.85

# Steps for Inflation Adjustment of Analysis

1. Estimate Real Prices of all input & output items  $P_t^i / P_t$  level
2. Make Assumptions about Future Inflation Rate
3. Determine Changes in Nominal Prices
4. Determine Nominal Interest Rate
5. Construct Pro-Forma Cash Flow Statement in Nominal Values
6. Estimate Taxable Income and Income Taxes (Nominal)
7. Determine Cash Requirements (Nominal)
8. Determine Financing Requirements (Nominal)
9. Calculate Nominal Net Cash Flows from Different Points of View
10. Deflate Nominal Value by General Price Index for Each Year to Obtain Real Cash Flow Statements