

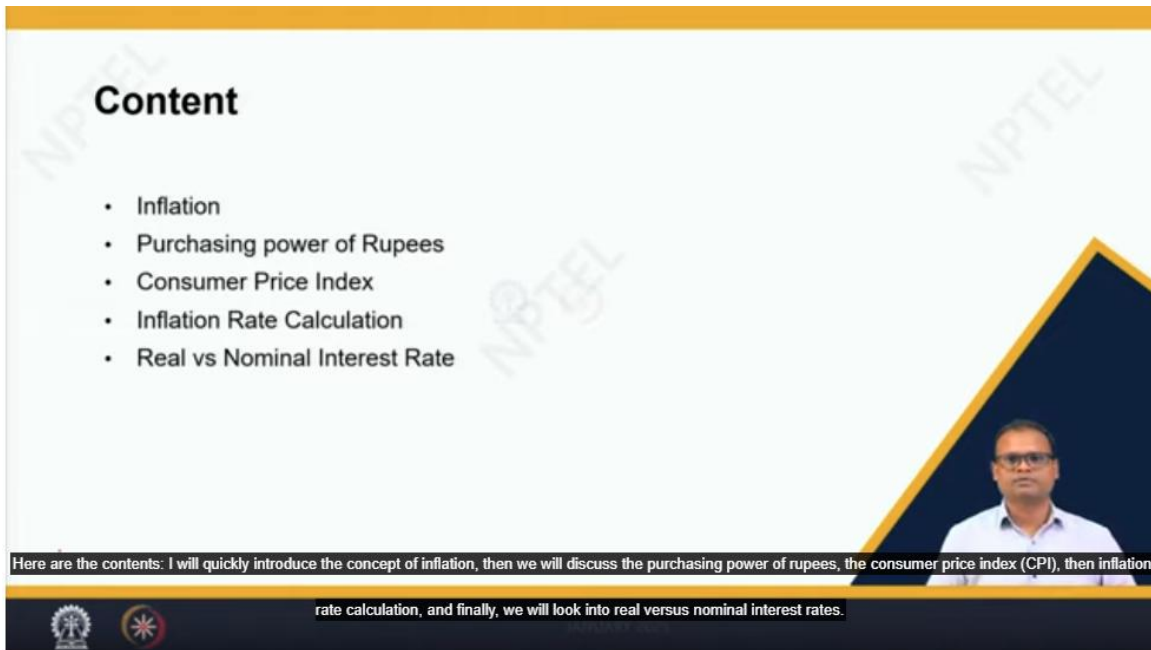
# MINERAL ECONOMICS AND BUSINESS

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## Lecture 33: Inflation - 1



**Content**

- Inflation
- Purchasing power of Rupees
- Consumer Price Index
- Inflation Rate Calculation
- Real vs Nominal Interest Rate

Here are the contents: I will quickly introduce the concept of inflation, then we will discuss the purchasing power of rupees, the consumer price index (CPI), then inflation rate calculation, and finally, we will look into real versus nominal interest rates.



Hello everyone, and welcome again to this course on Mineral Economics and Business. This is our lecture number 33, and this is the first lecture on inflation. Here are the contents: I will quickly introduce the concept of inflation, then we will discuss the purchasing power of rupees, the consumer price index (CPI), then inflation rate calculation, and finally, we will look into real versus nominal interest rates.

# Inflation

Inflation rate = % increase in price over time,

Coking coal

12,000	→	12,800
2023		2024

$$i_t = \frac{12,800 - 12,000}{12,000} \times 100$$
$$= 6.67\%$$

Multiply by 100. So, if you calculate this, it becomes 6.67 percent. This is for coking coal. Similarly, you can calculate, if you are buying an excavator for the mine, what

your inflation rate is.

As you know, the inflation rate is the percentage increase in price over time. For example, let's say we have coking coal. The coking coal per ton price is, let's say, 12,000 in 2023, which changed to, let's say, 12,800 in 2024.

Then the inflation rate, which we will denote as 'i,' is (12,800, which is the price in 2024, minus 12,000) divided by the initial price, which is 12,000. Multiply by 100. So, if you calculate this, it becomes 6.67 percent. This is for coking coal. Similarly, you can calculate, if you are buying an excavator for the mine, what your inflation rate is. This inflation means the prices are rising, and the purchasing power of rupees is declining.

## Inflation

- Inflation means prices are rising and the purchasing power of rupees is declining.
- The rate of inflation varies with the particular currency under consideration as well as the type of goods and services being purchased
- Inflation may become the most important factor in a mining investment, and it can rarely ignored in capital investment analyses.

The rate of inflation varies with the particular currency. What this means is that the Indian rupee, although in India, the inflation can be different than, let's say, a European country. Under consideration, as well as the type of goods and services being purchased. As I said, the inflation for coking coal can be different from the excavator inflation.

## Inflation


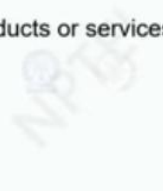

Impact of Inflation on Capital Costs in the Copper Industry Cost Estimate

Project	Date	Amount \$ millions	Cost per annual ton of copper produced
Toquepala, Peru	1959	\$ 237	\$ 1,700
Cuajone , Peru	1973	550	3,055
Cuajone , Peru	1977	1200	6,700
Cuajone , Peru	1980	1950	10,800

In the fourth column, you can see here the cost per ton of copper produced—how much cost we are going to spend to produce one ton of copper. Here, you can see in

1959 (it's a bit of old data, but it's relevant here), it was 1,700 in 1959, which went up to 3,055 dollars in 1973.

Inflation may become the most important factor in mining investment and can rarely be ignored in capital investment analysis.



## Inflation Rate

The inflation rate is the percentage increase in prices over a period

### Examples

The inflation rate for a group of products or services

#### Medical care


- 2024-2025: 2.5%
- 1990 – 2025: 154.9%

#### Food


- 2024-2025: 1.4 %
- 1990 - 2025: 76.9 %

#### The inflation rate for all products and services

- 2024-2025: 1.5% (annual inflation rate)
- 1990 - 2025: 75.6 %



First one is let us say medical care, it went from 2024 to 2025 the inflation rate is 2.5 percent.



To show, we have an example here which says the impact of inflation on capital cost in the copper industry. Cost estimates, like we have some copper mine in Peru, where in this table, the second column shows the year we are calculating, and maybe we have the capital cost in the third column. In the fourth column, you can see here the cost per ton of copper produced—how much cost we are going to spend to produce one ton of copper. Here, you can see in 1959 (it's a bit of old data, but it's relevant here), it was 1,700 in 1959, which went up to 3,055 dollars in 1973. It further went up to \$6,700 and \$10,800 in 1977 and 1980, respectively. So, the inflation rate, as I said, is the percentage increase in price over time.


So, we have an example here the inflation rate for a group of products or services. First one is let us say medical care, it went from 2024 to 2025 the inflation rate is 2.5 percent. ah from 1990 you can say from 2025 you can calculate ah this is just an example 154.9 percent similarly for food let us say it is 1.4 percent from 2024 to 2025 which is ah 76.9 percent when we see 1990 to 2025. If you combine all the kind of items you know let us say the inflation rate is 1.5 percent from 2024 to 2025 and overall from 1990 to 2025. So, there are

two things here one is you know the inflation rate it is typically calculate annual annually, but it can be monthly also.

### Inflation Rate vs The Value of Rupees

- The higher the inflation rate, the less the value of your rupees over time.
- The table below shows how much 100 rupee will be worth after certain years given certain inflation rates.

Years	Annual Inflation Rate at 2%	Annual Inflation Rate at 6%	Annual Inflation Rate at 15%
5	91	75	50
10	82	56	25
40	45	10	0.3



And second thing you know each item has its own inflation rate and to get the average rate you know we use something called CPI that we will see in our next slides. So, the higher the inflation rate, the less the value of your rupees over the time. The table below shows how much 100 rupees will be worth after certain years given certain inflation rate. So, what we have is 100 rupees. And what we are trying to see is over the years, let's say, like, you know, this 100, sorry, 1000 or 100 rupees, not 1000 here, 100 rupees, how it is, you know, the value is changing over 5 years, 10 years and 40 years.

with a different inflation rate in the row here. So, it is if the inflation rate is 2 percent, 6 percent, 15 percent how it is changing. So, if you can say for the first case when the inflation rate is 20 percent with time I know this 100 rupees become 91 rupees to 82 rupees to 45 rupees. And also if you keep the inflation the number of year constant and with different inflation rate it is changing from 91 rupees to 75 rupees to 50 rupees. So if there is inflation and you know we have the inflation rate is 15 percent for after 40 years the sundry rupees will become 0.3 rupees.

Now, how to compute the numbers in the previous table? For this, we use our formula, which is  $y_n$  equal to  $p$  divided by  $1 + i_i$  to the power  $n$ , where  $y_n$  equals the


purchasing power after n years, p is the initial amount,  $i_i$  is the inflation rate, and n is the number of years.

### Inflation Rate and Purchase Power

Example: If the inflation rate is 4% per year, what is the purchasing power of Rs. 1000 after 20 years?

$P = 1000$     $i_i = 4\% = 0.04$     $n = 20 \text{ yrs}$     $P = 1000$

$Y_n = ?$

$$Y_n = \frac{1000}{(1 + 0.04)^{20}} = \text{Rs. } 456.39$$


So, what does this mean? If you have 1000 rupees with a 4% inflation rate, the purchasing power becomes 456.39 after 20 years.

So, to see this, we have an example here. It says if an inflation rate is 4% per year, so our  $i_i$  is 4% per year, what is the purchasing power of 1000 rupees?


So, the initial amount P becomes 1000. thousand after 20 years. So, it is asked what is the value of  $Y_n$ , considering  $i$  equal to 4 percent (0.04),  $n$  equal to 20 years, and  $P$  equal to 1000. So, if you put it in that formula,  $Y_n$  equal to 1000 divided by 1 plus  $i_i$ , which is 0.04, to the power  $n$  ( $n$  is 20 here), so this becomes rupees 456. So, what does this mean? If you have 1000 rupees with a 4% inflation rate, the purchasing power becomes 456.39 after 20 years.


## Inflation

**Escalating inflation:** Prices rise at an increasing rate  
 Example: 3%, 4%, 5%, 6% for four consecutive years  
2020 21 22 23

**Disinflation:** Prices rise at a decreasing rate.  
 Example: 6%, 5%, 4%, 3% for four consecutive years.  
2020 21 22 23

**Deflation:** Prices rise at a decreasing rate.





And we have a third term, which is deflation, which is when the price rises at a decreasing rate, meaning the inflation is negative.

So, based on this, we have three terms related to inflation. One is called escalating inflation, where the prices rise at an increasing rate. For example, 3 percent, 4 percent. The inflation rate, as you know, let us say 2020 is 3 percent, 2021 is 4 percent, 2022 is 5 percent, and 2023 is 6 percent.

For four consecutive years, we call it escalating inflation. So, if you want to plot this, like this is here, and this is, let us say, inflation rate  $i_i$  in percent. So, if you try to plot it like this, it is continuously increasing the inflation rate. So, this is called escalating inflation. So, we have disinflation, like price rise at a decreasing rate. I mean, there is positive inflation, but the inflation is decreasing, like from let us say 6 percent in 2020, 2021, 2022 it is 4 percent, and 2023, let us say, it is 3 percent.

So, if you plot it, you know, it becomes this: year versus inflation rate  $i_i$ . So, it will look something like this. So, this is called disinflation. And we have a third term, which is deflation, which is when the price rises at a decreasing rate, meaning the inflation is negative. So, we have countries like, let us say, Japan, where we have deflation.

So, now coming to how do you know what the inflation rate is? So, the inflation rate is measured using indices that track price changes in a basket of goods and services over time. A price index is a statistical measure that reflects changes in the average price level relative


to a base year. In India, inflation is primarily tracked using two main price indices. The first one is the wholesale price index, which is WPI, and the consumer price index.

So, we will quickly see what these are. So, the first one is the wholesale price index, which

## Wholesale Price Index (WPI)

- The WPI measures the price changes in the **wholesale market**, i.e., the prices at which goods are sold in bulk and before they reach the retail market.
- **Items Included:** The WPI includes:
  - **Primary Articles:** Like food items (cereals, pulses, vegetables), non-food items (minerals, metals), etc.
  - **Fuel and Power:** Petrol, diesel, LPG, etc.
  - **Manufactured Products:** Items like textiles, machinery, chemicals, etc.

So, there are items in here, primarily categorized as primary articles, which are like food and non-food items, such as minerals and metals. In food, we have cereals, pulses, vegetables, etc.

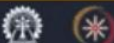


is WPI, as I said. So, it measures the price changes in the wholesale market. That is the price at which goods are sold in bulk before they reach the retail market. So, there are items in here, primarily categorized as primary articles, which are like food and non-food items, such as minerals and metals. In food, we have cereals, pulses, vegetables, etc.

## Consumer Price Index (CPI)

- The CPI measures the average change in prices paid **by consumers** for goods and services over time. It is considered the most widely used measure of inflation in India.
- **Items Included:** The CPI includes a wide range of goods and services, grouped into categories like:
  - **Food and Beverages:** The largest component, covering food items such as cereals, vegetables, fruits, dairy products, etc.
  - **Housing:** Includes rent, repairs, and maintenance costs.
  - **Clothing and Footwear:** Prices of garments, footwear, etc.
  - **Health:** Medical services, medicines, etc.
  - **Transportation:** Includes petrol, diesel, public transport, etc.
  - **Education:** Costs of education, books, and related materials.
  - **Recreation:** Entertainment and recreational activities.
  - **Other Miscellaneous Goods and Services.**

Before, it was for the wholesale market, and this is for the consumers for goods and services over time, so it is considered the most widely used measure of inflation in India.



And the second category is fuel and power, where we have petrol, diesel, LPG, and others. And then we have the third category as manufactured products, which include textiles, machinery, and chemicals. So, what we do is we track how the prices in the wholesale market change for these three categories of items. The Consumer Price Index, which is called CPI, measures the average change in price paid by consumers. Before, it was for the wholesale market, and this is for the consumers for goods and services over time, so it is considered the most widely used measure of inflation in India.

And the items included here are in a couple of categories, as we can see here. The first one is food and beverages, the second one is housing, clothing, and footwear, health, transportation, education, recreation, and other goods and services. So, you can pause the video and see what the different items are in different categories. So, to calculate, as we said, this CPI and WPI—everywhere, in both cases, different items are considered, but the weightage that is given to calculate the CPI and WPI for different items is different. For example, food is considered in both WPI and CPI, but in WPI, it is around 15% weightage, whereas in CPI, it is around 46%. So, to calculate the CPI, what we do is consider the monthly price data for a basket of goods and services from urban and rural areas

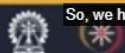
and, as we saw, the items included are food, clothing, housing, fuel, and other commodities. The CPI is then weighted based on the spending habits of the average consumer, and weights are determined from the Consumer Expenditure Survey (CES) by the National Statistical Office (NSO).

## Example

In a country, the government tracks the price of a fixed basket of goods and services each year. The prices and quantities of four items in the basket for **Year 1** (Base Year) and **Year 2** are provided below. Assume the following weights for each item based on its share in total expenditure:

Item	Price in Year 1 (2023)	Price in Year 2 (2024)	Quantity	Weight in Basket
Food (Rice)	₹50	₹55	100 kg	0.4
Housing (Rent)	₹5000	₹5500	1 unit	0.3
Transportation (Bus fare)	₹20	₹25	200 rides	0.2
Education (Tuition Fees)	₹10000	₹12000	1 unit	0.1

1. Compute the Consumer Price Index (CPI) for Year 2.
2. Determine the inflation rate from Year 1 to Year 2.



So, we have the example here. Let us say, in a country, the government tracks the prices of a fixed basket of goods and services each year.

So, we will see an example, which will make things clearer. So, we have the example here. Let us say, in a country, the government tracks the prices of a fixed basket of goods and services each year. The prices and quantities of four items in the basket for Year 1, which is our base year (let us say, in this case, 2023), and Year 2, which is 2024, are provided below.

So, assume the following weights for each item based on its share in total expenditure. So, based on the weights, you can see in this column the number of units, average unit to be used is given here. So, you know, in this, the first column tells about the different items like, you know, food, housing, transportation, and education. So, what we have is, you know, in the second column is in 2023, what was the price of food, let us say rice, which is \$50. Rupees, and then the housing, the rent was, let's say, 5000, and like the transportation, the bus fare was 20 rupees, and the education, which is like 20, you know, the tuition fee is 10,000 rupees. So in year two, in 2024, it was increased to 55 for food, 5500 for housing, transportation was from 20 to 25 rupees.

And the tuition fees increased from 10,000 to 12,000. And based on the average, the consumption is, let us say, 100 kg of rice, 1 unit of, let us say, housing because we are going to rent 1 house, 200 rides, and 1 unit for education. So, this is what we are spending. And, you know, the question here is how to compute the CPI, consumer price index, for year number 2 and also how to determine the inflation rate considering the average of all the items. So to solve this, I put this table here.

So if you see, you know, first we have item, then price in year one, which is 2023. So year two is 2024, and the quantity is here. So how much we are going to spend on food in, let's say, year one, which is the cost of item. So, it becomes 50 times your 100 quantity. So, 50 into 100 equals to 5000 here.

**Example**

Item	Price in Year 1 2023	Price in Year 2 2024	Quantity	Cost of item 2023	Cost of item 2024
Food (Rice)	₹50	₹55	100 kg	$50 \times 100 = 5000$	$55 \times 100 = 5500$
Housing (Rent)	₹5000	₹5500	1 unit	$5000 \times 1 = 5000$	$5500 \times 1 = 5500$
Transportation (Bus fare)	₹20	₹25	200 rides	$20 \times 200 = 4000$	$25 \times 200 = 5000$
Education (Tuition Fees)	₹10000	₹12000	1 unit	$10000 \times 1 = 10,000$	$12000 \times 1 = 12000$
				$\Sigma = 24,000$	$= 28,000$

so uh like once you calculate all this thing and sum it up what we need to do to get our cpi is to use this equation so total cost in a year and divided by total cost in a base

Similarly, for housing we have 1 unit into we are spending 5000 for rent into 5000 into 1 equal to 5000 here. we have 200 riders the rights of for the bus fare so 20 into 200 becomes 4,000 here and similarly the education is 10,000 into 1 unit is so 10,000 into 1 is sorry 10,000. So, 10,000 rupees here. Similarly, if you want to calculate the cost of item in 2024 it becomes 55 into 100 which is 5500 ah similarly for rent we have 5500 into 1 equal to 5500 this the the bus fare is increased to 25 so 25 into 200 equal to 5000 rupees and then for the tuition fees is 12,000 into 1 which becomes 12,000 rupees so first what you have to do is to calculate what is the total cost per item you know in a year and if you sum it up the summation becomes you know 24,000 here in 2023 and it is increased to let's say 28,000 in 2024. so uh like once you calculate all this thing and sum it up what we need to do to get our cpi is to use this equation so total cost in a year and divided by total cost in a base here so for us uh let's say in a year is 2024 and the base here is let's say 2023 so on the cost in 2024 was 28000 and cost in 2023 was 24000.

## Example

$$\text{CPI} = \frac{\text{Cost in a year}^{\text{---2024}}}{\text{Cost in base year}^{\text{---2023}}} \times 100$$

Cost in 2024 = 28,000  
Cost in 2023 = 24,000

$$\text{CPI}_{2024} = \frac{28,000}{24,000} \times 100 = 116.67\%$$
$$\text{CPI}_{2023} = \frac{24,000}{24,000} \times 100 = 100\%$$

So, CPI becomes 28000 divided by 24000. So, this is ah you know 116.67 percent and similarly this is for CPI 2024. Now, if you want to calculate the CPI for 2023 itself. So, in 2023 the total cost was 24000 and the base year itself it is 24000 into 100 is 100 so now to compute you know take the average and get the

## Consumer Price Index (CPI)

How to Compute Inflation Rates:

$$i_i = \left( \frac{\text{CPI}_B}{\text{CPI}_A} - 1 \right) 100$$

$$i_i = \left( \frac{\text{CPI}_{2024}}{\text{CPI}_{2023}} - 1 \right) \times 100$$

$$= \left( \frac{116.67}{100} - 1 \right) \times 100 = 16.67\%$$

$$\text{CPI}_B = \text{CPI}_{2024} = 116.67$$

$$\text{CPI}_A = \text{CPI}_{2023} = 100$$

you know inflation rate considering all those items it you can use the equation here where  $i = \frac{CPI_b - CPI_a}{CPI_a} \times 100$  so what is this  $CPI_b$  for us is the CPI in 2024 because we want to calculate the inflation in 2024 compared to 2023. So,  $CPI_a$  here is equal to  $CPI_{2023}$ . So, this was our 116.67, and this is 100 from the previous slide that we calculated. So, for us, this  $i$  becomes  $i = \frac{100 - 116.67}{116.67} \times 100$  like this is 100  $CPI_{2024}$  divided by  $CPI_{2023}$  minus one into hundred equals to this is a hundred sixteen point divided by 100 minus 1 into 100. So, this becomes 16.67 percent inflation. So, in this lecture today, you know, what we learned was how to calculate the individual inflation and also using CPI how we can calculate the inflation rate for a particular country. So, this ends our lecture today, lecture number 33.