Lecture 3
Price Level and Inflation

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Lecture Outline

▶ Measuring inflation

▶ Adjusting for inflation

▶ Does CPI measure "true" inflation?

▶ Costs of inflation

▶ Inflation and interest rates

Measuring Inflation

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The New York Times

Business
Takeaways from the July inflation report.

By Jeanna Smialek
10 August 2022
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Inflation slowed to 8.5 percent as fuel costs cooled, but price increases on many other goods and services remain rapid.

Inflation cooled in July as gas prices and airfares fell, a welcome reprieve for consumers and economic policymakers but not yet a conclusive sign that price increases are turning a corner.

The Consumer Price Index climbed 8.5 percent in the year through July, compared with 9.1 percent the prior month, a bigger slowdown than economists had projected. After stripping out food and fuel costs to get a sense of underlying price pressures, prices climbed by 5.9 percent through July, matching the previous reading.

Measuring Inflation

- Rate of inflation is the annual percentage rate of change of general price level
  - Rate of inflation between 2020 and 2021 is given by: $\dfrac{P_{2021} - P_{2020}}{P_{2020}}$

- How do we measure *general* price level?
  - Thousands of goods and services in the economy
  - How do we aggregate all the different prices?
  - How do we assign weightages?

Measuring Price Level

▶ Consumer price index (CPI)
  ▷ Most common measure of price level
  ▷ Other measurements of price level include
    ■ core inflation
    ■ producer price index
    ■ import & export price index

Measuring Price Level

- ▶ The CPI measures
  - ▶ The **cost** of a standard basket of goods and services in current year *relative* to the cost of the same basket of goods and services in the base year

$$CPI = \frac{Cost\ of\ base-year\ basket\ of\ g\&s\ in\ current\ year}{Cost\ of\ base-year\ basket\ of\ g\&s\ in\ base\ year}$$

  - ▶ The basket of goods and services is based on the average consumption patterns of households in the base-year
    - ■ Collected via detailed expenditure survey
  - ▶ Base year changes periodically
  - ▶ Conventionally, CPI is multiplied by 100 to get rid of decimal point. However, we will keep our CPI in decimal form as calculation is simpler

Calculating CPI

▸ An example

▹ Base year is 2015, current year is 2020

▹ A typical basket of goods and services consumed by a household consists of:

1. 1 rental of a two-bedroom apartment

2. 60 hamburgers

3. 10 movie tickets

▹ To compute CPI, we need to compute the *cost* of the basket of goods and services in the current year and in the base year

Calculating CPI

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Item	Monthly Cost in 2015
Rent (2-bedroom apartment)	$750
Hamburgers (60 at $2 each)	120
Movie tickets (10 at $7 each)	70
Monthly expenditures	**$940**

Item	Monthly Cost in 2020
Rent (2-bedroom apartment)	$945
Hamburgers (60 at $2.50 each)	150
Movie tickets (10 at $8 each)	80
Monthly expenditures	**$1,175**

Calculating CPI

▶ CPI = $\dfrac{Cost\ of\ base-year\ basket\ of\ g\&s\ in\ current\ year}{Cost\ of\ base-year\ basket\ of\ g\&s\ in\ base\ year}$

= (1,175/940) = 1.25

▶ Cost of living in 2020 is 25% higher than in 2015

  ▹ CPI for the base year is always 1.00

  ▹ CPI for a given period is the cost of living in that period relative to what it was in the base year

Calculating Inflation

▶ The rate of inflation is the **annual percentage rate of change in the price level**

▶ Inflation in 2016
= (2.40 − 2.37)/2.37
= 0.0126 = 1.3%

▶ The Great Depression
  ▷ Period of falling output and prices
  ▷ When inflation rates are negative there is **deflation**

Year	CPI	Inflation
2015	2.37	
2016	2.40	1.3%
2017	2.45	2.1%
2018	2.51	2.4%
2019	2.56	2.0%

Year	CPI	Inflation
1929	0.171	
1930	0.167	−2.3%
1931	0.152	−9.0%
1932	0.137	−9.9%
1933	0.130	−5.1%

Adjusting for Inflation

Adjusting for Inflation

- **Nominal quantity:** measured in terms of current dollar value; include effects of inflation

- **Real quantity:** measured in physical terms; exclude effects of inflation

- 2 types of adjustment for inflation:

    1. **Deflating**: convert nominal quantities measured into real terms

    2. **Indexing**: convert real quantities into current-dollar terms

Deflating

▶ **Deflating**: divide a nominal quantity by its price index to express the quantity in real terms

▶ When comparing values over time, use real quantities instead of nominal quantities to eliminate effects of inflation from comparison

E.g. Comparing Family Income in 2015 and 2020

▶ A family earned $40,000 in 2015, and $44,000 in 2020. Is the family better off?

Year	Nominal Income	CPI	Real Income
2015	$40,000	1.00	$40,000/1.00 = $40,000
2020	$44,000	1.25	$44,000/1.25 = $35,200

▶ To get real income: divide nominal income by the CPI

▶ Compare real income
  ▹ $40,000 in 2015 has the greater purchasing power

E.g. Real Wages of U.S. production workers

▶ The real wage is the wage paid to the worker measured in terms of purchasing power

▷ The real wage for any given period is calculated by dividing the nominal wage by the CPI for that period

Year	Average Wage	CPI	Real Average Wage
1970	$3.40	0.388	$3.40 / 0.388 = $8.76
2019	$23.51	2.56	$23.51 / 2.56 = $9.18

▶ U.S. production worker wages

▷ Real wages stayed roughly the same between 1970 and 2019 despite the fact that the nominal wage in 2019 was almost 7 times the nominal wage in 1970

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Production Workers' Wages, 1970 - 2019
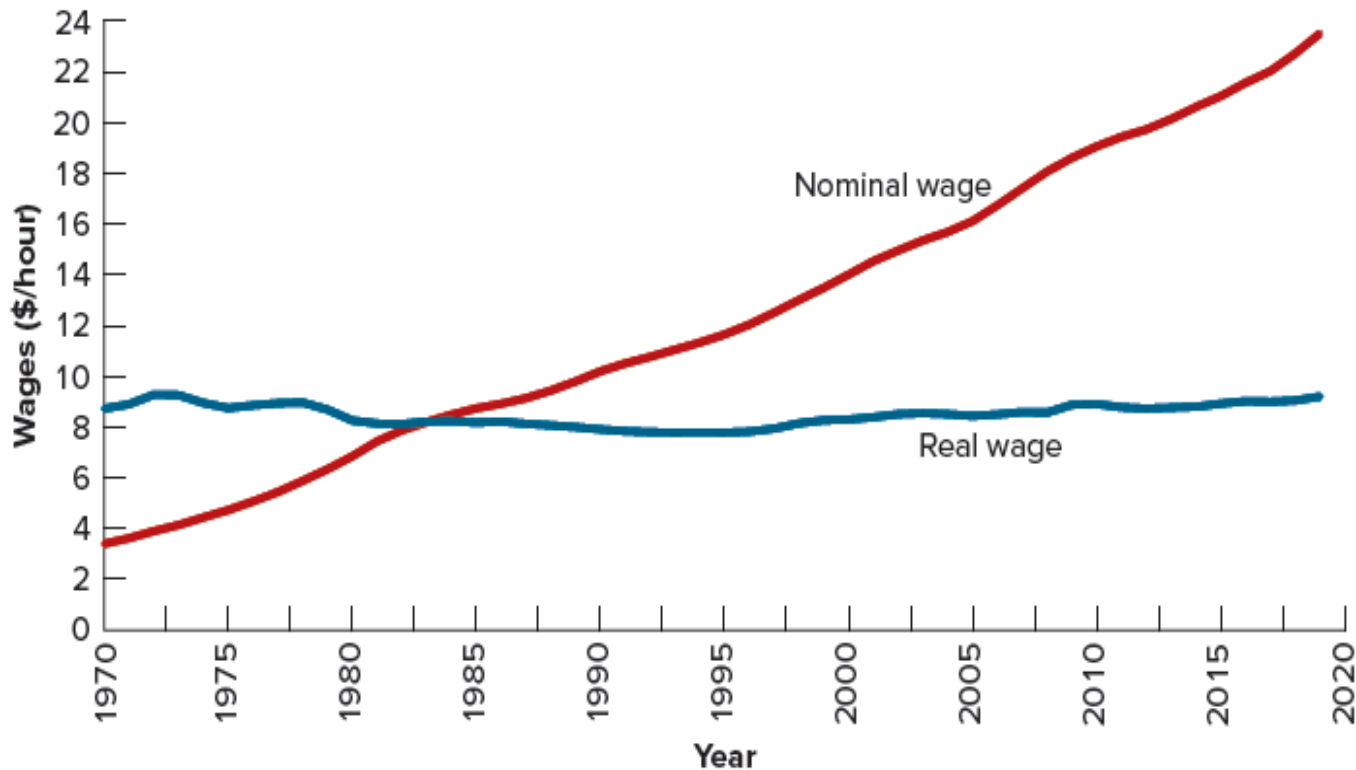
Indexing

- **Indexing** increases a nominal quantity each period by an amount equal to the percentage increase in a specified price index
  - Indexing prevents the purchasing power of the nominal quantity from being eroded by inflation
- Indexing automatically adjusts certain values, such as Social Security payments, by the amount of inflation
  - If prices increase 3% in a given year, the Social Security recipients receive 3% more
  - Indexing is sometimes included in labor contracts

E.g. Adjusting a Labour Contract for Inflation

- ▶ An indexed labour contract
  - ▷ First year wage is $12 per hour
    - Real wages rise by 2% per year for next 2 years
  - ▷ Price index is 1.00 in first year, 1.05 in the second, and 1.10 in the third
  - ▷ Nominal wage is real wage times the price index

Year	Real Wage	Price Index	Nominal Wage
1	$12.00	1.00	$12.00
2	$12.24	1.05	$12.85
3	$12.48	1.10	$13.73

Does CPI Measure "True" Inflation?

CPI and Inflation

▶ CPI may not properly measure inflation due to:

1. Quality adjustment bias
2. Substitution bias

▶ Overestimation of inflation would lead to

1. Unnecessarily increases government spending
2. Underestimation of increase in the standard of living

Quality Adjustment Bias

- **Quality adjustment bias**: failure to adjust adequately for improvements in the quality of goods and services
  - PC with 20% more memory has 20% higher price
    - Not the same PC as the one with less memory
  - If no adjustment is made for quality, inflation will be overstated
  - Adjusting for quality is difficult
    - Large numbers of goods
    - Subjective differences
  - Incorporating new goods is difficult
    - No base year price for this year's new goods

Substitution Bias

▸ CPI is calculated using a fixed basket of goods and services
  ▹ When the price of a good increases, consumers buy less and substitute other goods
  ▹ Failing to account for substitution overstates inflation

▸ Example: base year cost of market basket

Item	2015 price	2015 Spending
Coffee (50 cups)	$1.00	$50.00
Tea (50 cups)	$1.00	$50.00
Scones (100)	$1.00	$100.00
Total		$200.00

Substitution Bias

▶ In 2020, coffee and scones are more expensive

- ▷ Buying exactly the same basket of goods costs $300, compared to $200 in 2015
- ▷ CPI = 300/200 = 1.50

Item	2020 price	2020 Spending
Coffee (50 cups)	$2.00	$100.00
Tea (50 cups)	$1.00	$50.00
Scones (100)	$1.50	$150.00
Total		$300.00

Substitution Bias

▶ Actually, consumer substitutes tea for coffee
  ▷ Purchase of scones remains constant

Item	2020 price	2020 Spending
Coffee (0 cups)	$2.00	$0.00
Tea (100 cups)	$1.00	$100.00
Scones (100)	$1.50	$150.00
Total		$250.00

▶ True CPI for consumer is 250/200 = 1.25

▶ CPI estimate of 1.50 is 25% higher than the consumer's experience

Costs of Inflation

Price Level vs Relative Price

- The **price level** is a measure of the overall level of prices at a particular point in time
  - Measured by a price index such as the CPI
- The **relative price** of a specific good is a comparison of its price to the prices of other goods and services
- E.g. there is a huge increase in the price of new car, but prices of other goods and services remain stable
  - Increase in the relative price of new car is large
  - Overall price level and inflation increase by a small amount

Price Level vs Relative Price

- Inflation can be high without affecting relative price

- E.g. all prices in the economy, including wages (price of labour), go up by 10 percent each year

  - Inflation rate is 10 percent

  - Relative prices remain unchanged

  - People's ability to buy goods and services is unaffected by inflation

True Costs of Inflation

1. "Noise" in the price system

2. Distortions of the tax system

3. "Shoe-leather" costs

4. Unexpected redistribution of wealth

5. Interference with long-term planning

"Noise" in the Price System

▶ Prices transmit information about
  ▷ The cost of production and
  ▷ The value buyers place on buying an additional unit

▶ When inflation is high
  ▷ Buyers and sellers can't easily tell whether
    ■ The relative price of this good is increasing OR
    ■ Inflation is increasing the price of this good and all others
  ▷ Response to changing prices is tentative and slow
  ▷ Reduction in efficiency

Distortions of Tax System

- **Bracket creep**: inflation raises people's nominal incomes would force them into higher tax bracket even when their real incomes may not have increased
  - Higher tax brackets have a higher tax rate
- Solution: *index* income tax brackets to avoid bracket creep

Distortions of Tax System

- Not all taxes are indexed
- *Capital depreciation allowance* encourages purchase of capital goods
  - Allows firms to deduct a share of the purchase price from taxable profits
  - E.g. Machine cost is $1,000 and its useful life is 10 years
    - Capital depreciation allowance of $100 per year
    - $100 in year 1 is worth more than $100 in year 10 because of inflation
- In times of high inflation, investment in plant and equipment decreases

"Shoe-leather" Costs

- If there is no inflation, cash holds its value over time
- When inflation is high, cash loses value over time
- Manage cash balances to limit losses
  - More frequent, smaller withdrawals cost consumers and businesses time, travel – a real cost of inflation
  - Banks process more transactions, increasing costs – another real cost of inflation
  - Costs of managing cash holding are called "**shoe- leather**" costs, referring to the cost of frequent trips to the bank

Unexpected Redistribution of Wealth

▸ Unexpected inflation redistributes wealth

1. Suppose workers' salaries are not indexed and inflation is higher than anticipated
   ▹ Salaries lose purchasing power
   ▹ Employers gain at the expense of workers

2. Unexpectedly high inflation benefits borrowers at the expense of lenders
   ▹ Borrowers repay with dollars worth less than anticipated

Interference with Long-Term Planning

- Some decisions have a long time horizon, e.g. investment strategies, retirement planning
  - High and erratic inflation makes planning difficult
- Given the costs of inflation, most economists agree that *low and stable* inflation promotes a healthy economy

Hyperinflation

▶ Hyperinflation is an extremely high rate of inflation

    ▷ E.g. Germany in 1923, inflation rate of 102,000,000 percent. Employers paid workers twice a day; many people's life savings became worthless

    ▷ Hyperinflation greatly magnifies the costs of inflation

Inflation and Interest Rates

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Inflation and Interest Rates

- The **real interest rate** is the annual percentage increase in the purchasing power of financial assets

- The **nominal interest rate** (market interest rate) is the annual percentage increase in the nominal value of an asset

- Real interest rate

  = nominal interest rate − inflation rate

- $r = i - \pi$

- Your friend, Jane, is borrowing $1000 from you for one year. She will pay you interest for the loan
- How much should the interest rate be?
- You would like to be compensated for deferring your consumption
    - Real interest rate
- You know that with inflation, a dollar in a year time worth less than a dollar today, and you would to be compensated for inflation
- Nominal interest rate = real interest rate + inflation rate
- Say, r = 2%, π = 3%, i would be 5%, and Jane will pay you an interest of $50 at the end of one year

Inflation and Interest Rates

- Note that at the time when you lend Jane $1000, actual inflation rate is not yet known
  - You have to anticipate the inflation rate, i.e. expected inflation rate

- High *unexpected* inflation hurt lenders, benefit borrowers
  - Say inflation rate turns out to be 10%, your real interest rate is -5%

- High inflation rate, if expected, does not hurt lenders, as lenders will demand a higher nominal interest rate
  - What nominal interest rate would you demand from Jane if you expected inflation rate to be 20%

- The **Fisher effect** is the tendency for nominal interest rates to be high when inflation is high and low when inflation is low

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U.S. Inflation and Interest Rates, 1970 - 2019
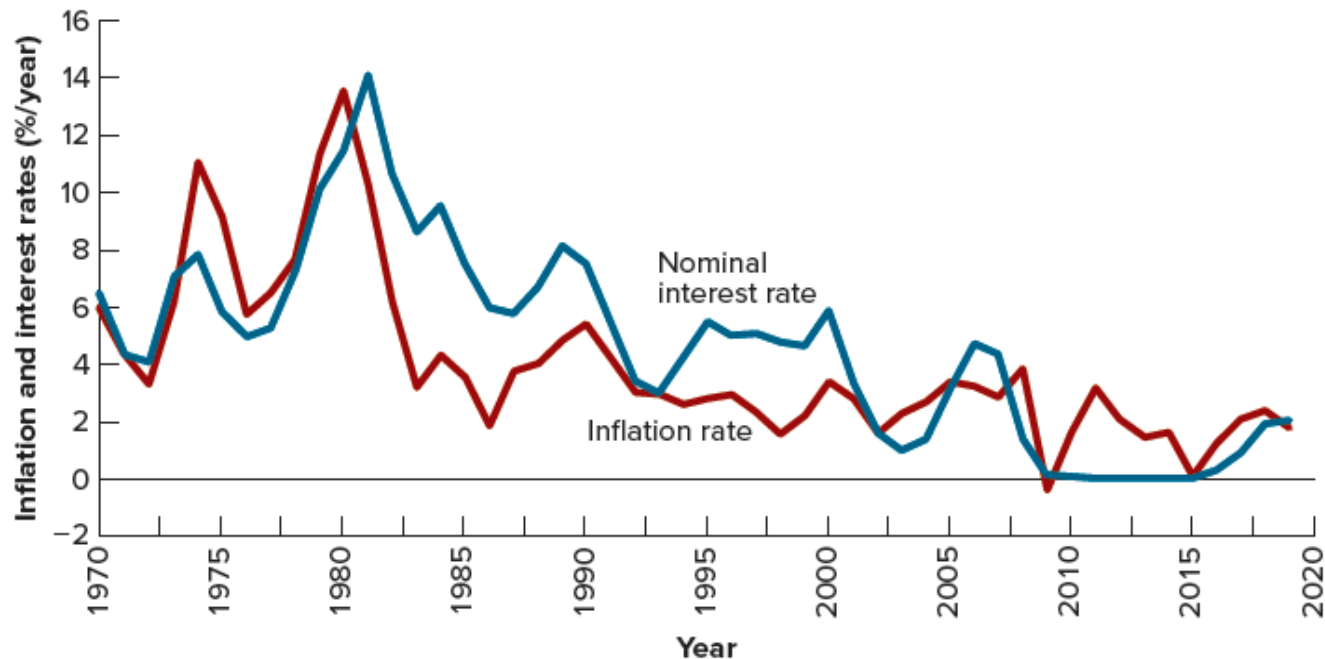
THANKS!

Any questions?

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