THEORY OF INFLATION DETERMINATION

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AGENDA

- An overview: stylized-fact of inflation
- General theory of inflation: Long-run perspective
- General theory of inflation: Business cycle perspective and inflation dynamic
- Inflation dynamic and policy implications
- Appendix: cost of inflation

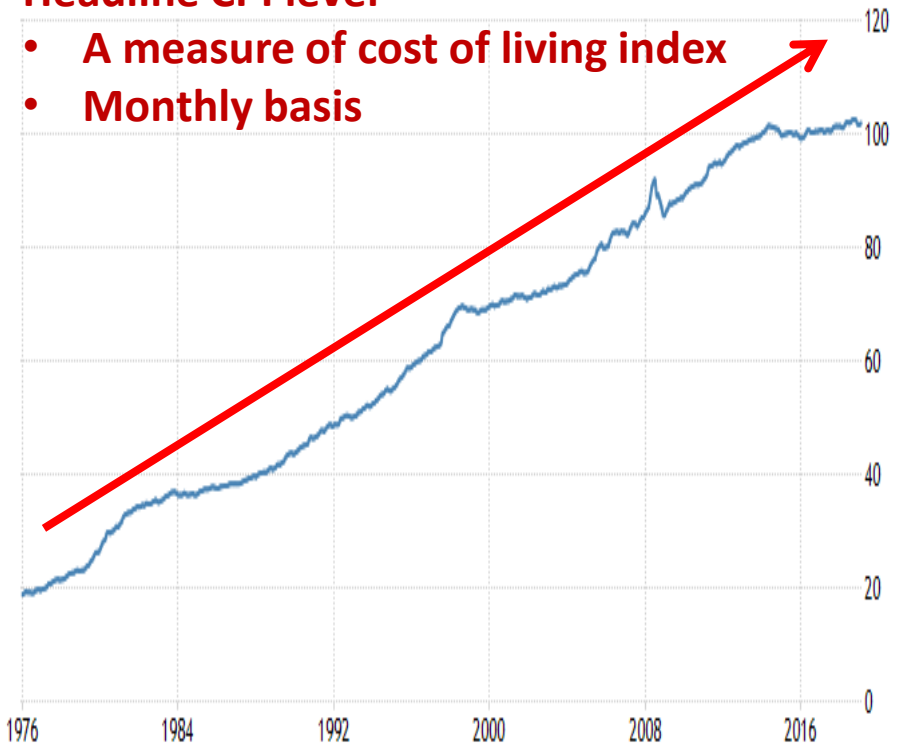
An overview: stylized-fact of inflation

General concept of inflation

Inflation is a rise in general price level.

Headline CPI level

- **A measure of cost of living index**
- **Monthly basis**



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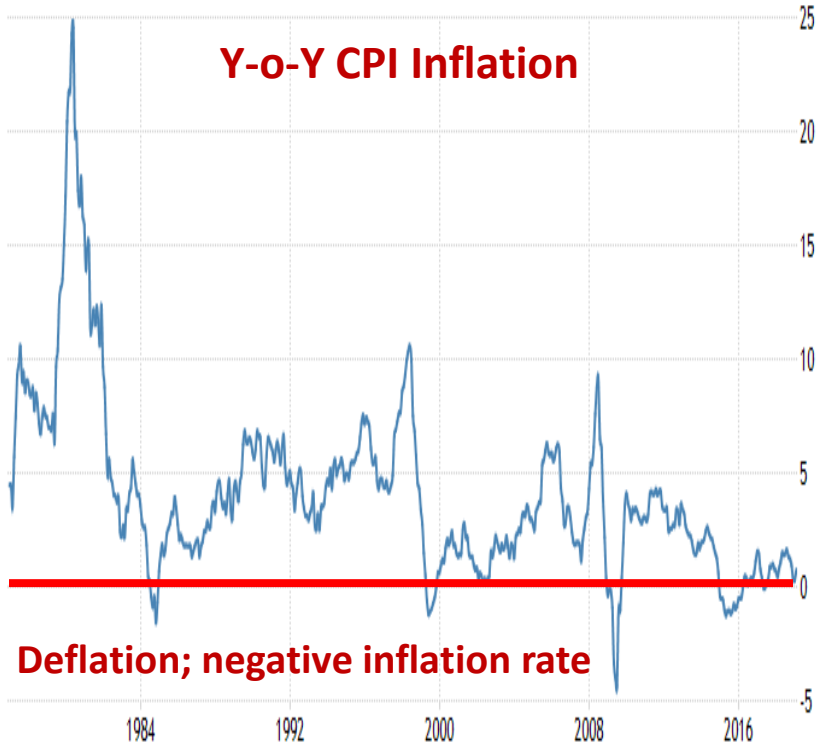

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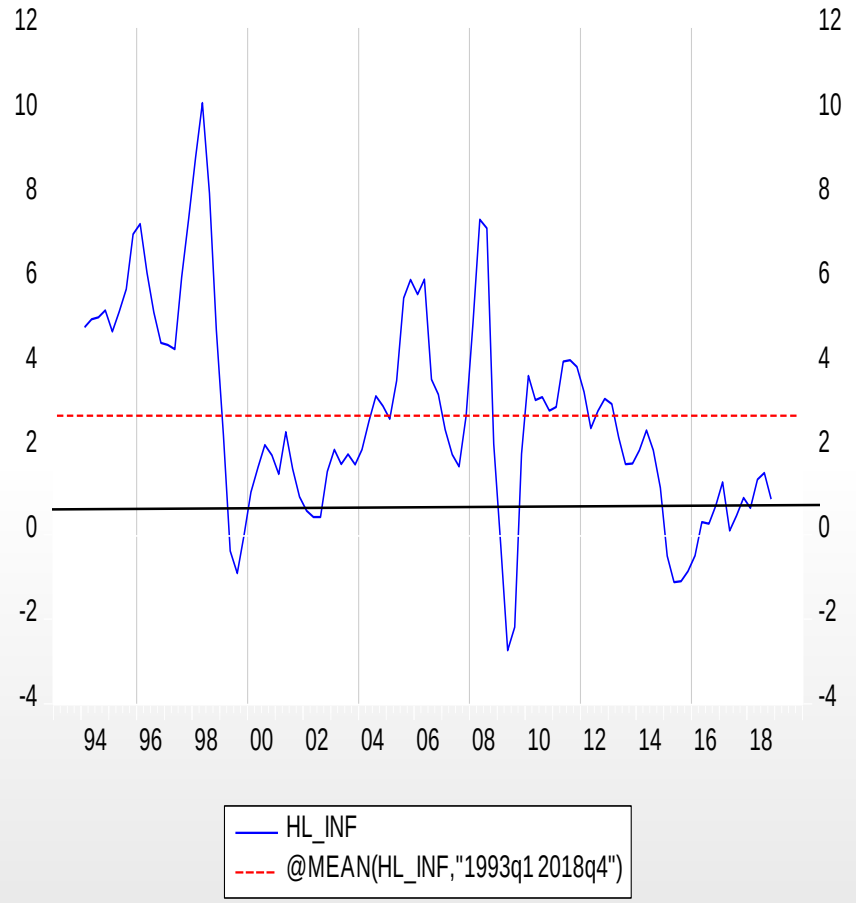
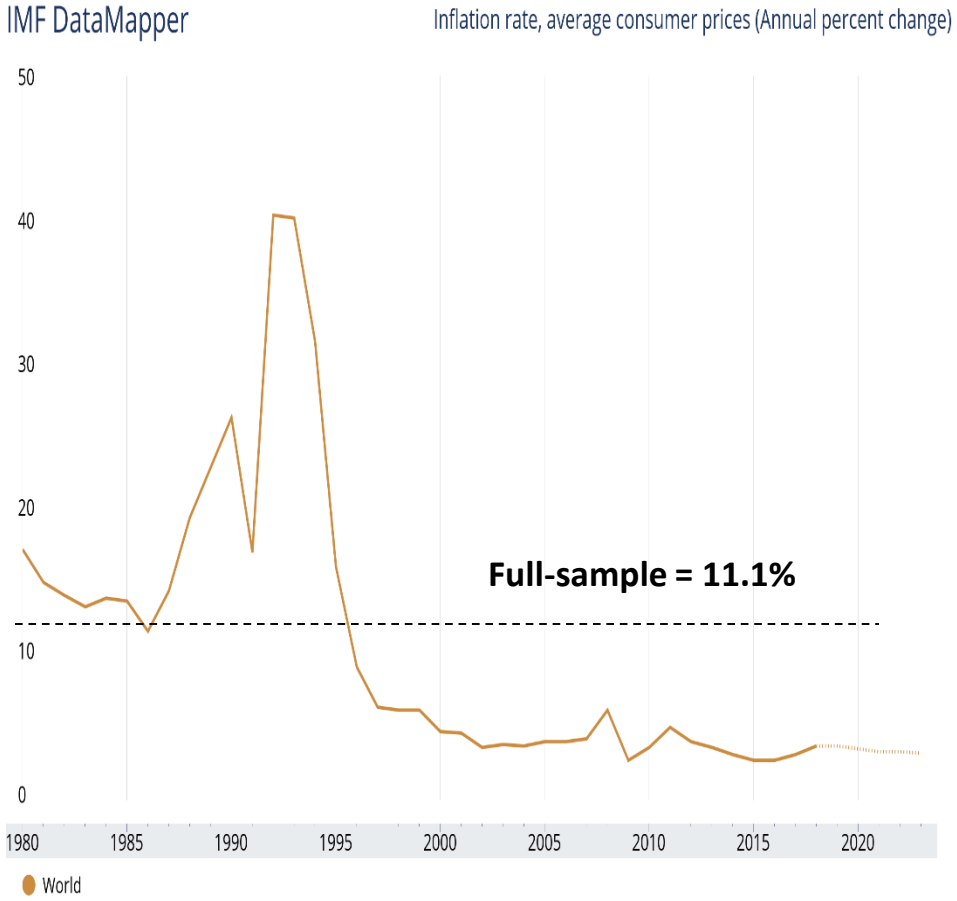
Stylized facts 1 “Positive (average) inflation is a global phenomena"

***Average* inflation rate is positive; overtime, cost of living has increased.**





Global inflation rate (annual)

©IMF, 2018, Source: World Economic Outlook (October 2018)

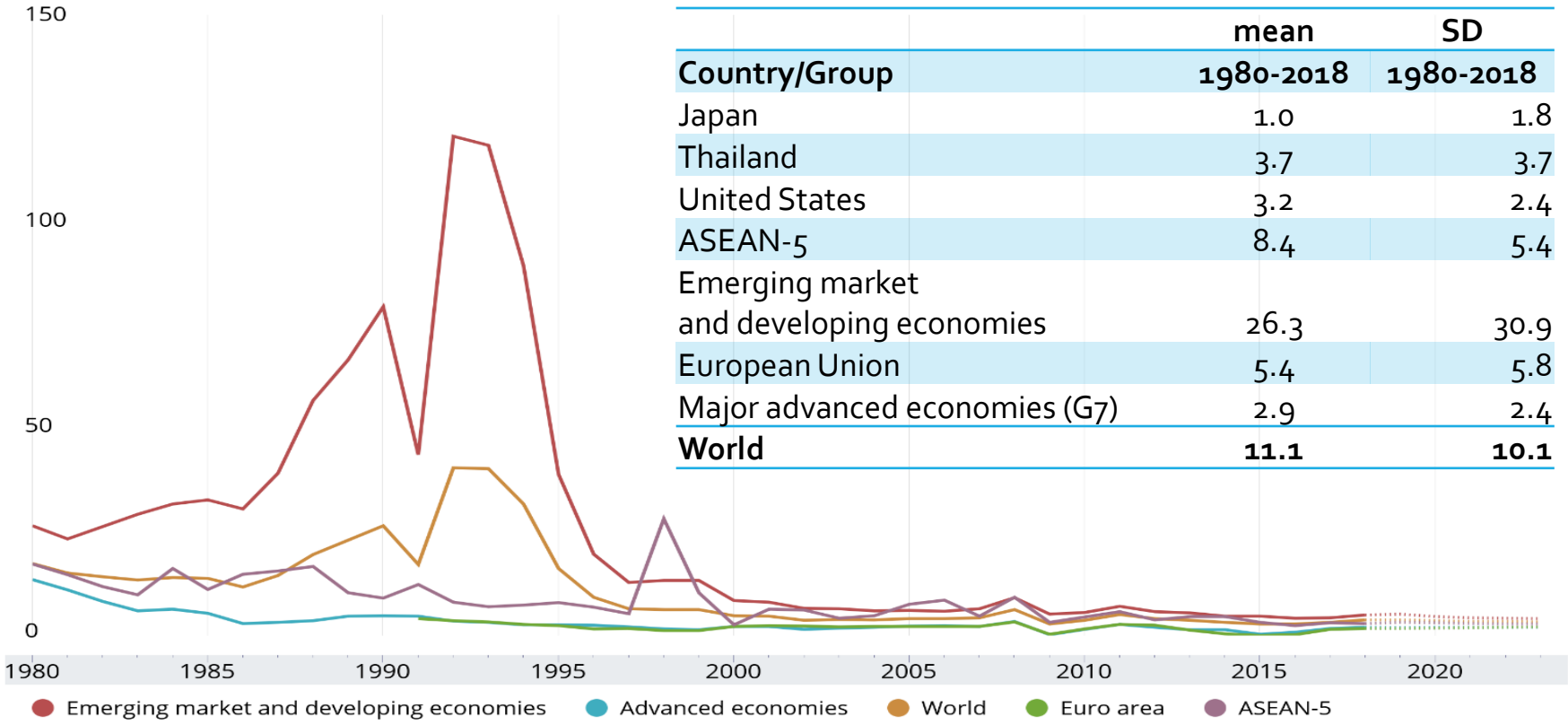
Stylized facts 2 “inflation outcome has varied across countries"

2.1 Inflation rates among the advanced economies have been lower than those in emerging markets

2.2 Lower average inflation rate *tends to be associated* with lower inflation volatility.

IMF DataMapper

Inflation rate, average consumer prices (Annual percent change)



	mean	SD
Country/Group	**1980-2018**	**1980-2018**
Japan	1.0	1.8
Thailand	3.7	3.7
United States	3.2	2.4
ASEAN-5	8.4	5.4
Emerging market and developing economies	26.3	30.9
European Union	5.4	5.8
Major advanced economies (G7)	2.9	2.4
World	**11.1**	**10.1**

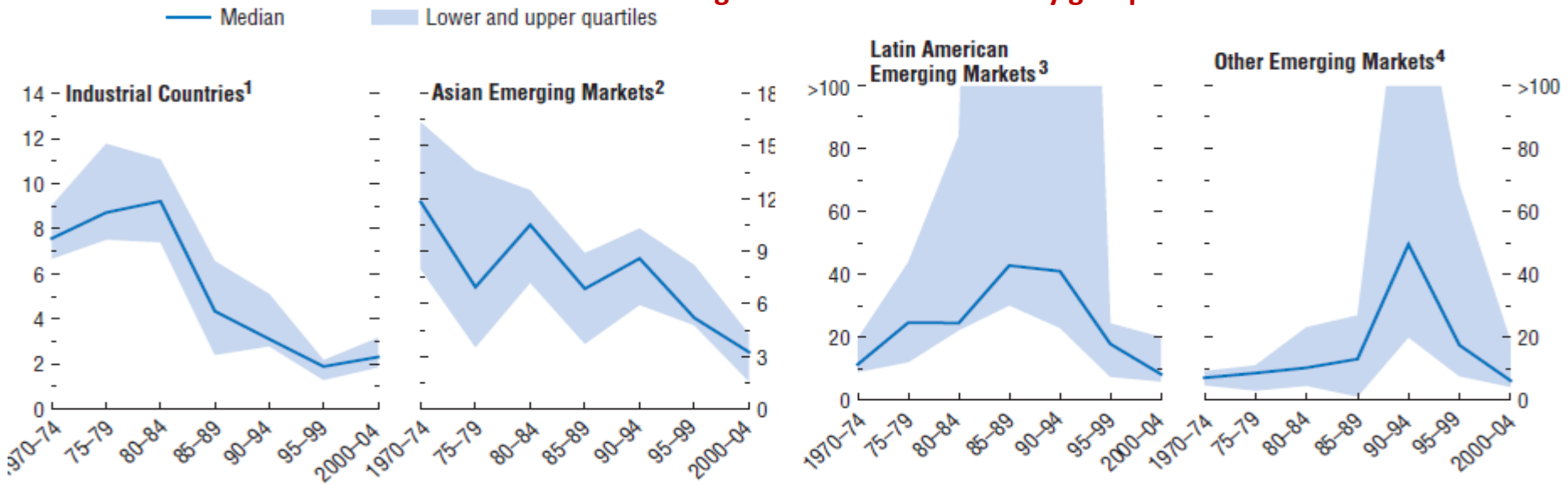
Stylized facts 3 “Declining trend of inflation rate has been a global phenomena.”

Inflation rate has slowly declined among different countries; average inflation during the 2000s has been much lower than that of before 2000s.

Average sample of inflation of selected countries

Country/Group	1980-1984	1985-1990	1991-1994	1995-1999	2000-2004	2005-2009	2010-2014	2015-present	before 2000	after 2000	1980-2018
Japan	3.9	1.1	1.8	0.4	-0.5	0.0	0.4	0.6	**1.9**	**0.1**	**1.0**
Thailand	8.4	3.2	4.6	5.1	1.7	3.2	2.8	0.2	**5.3**	**2.0**	**3.7**
United States	7.5	3.6	3.2	2.3	2.6	2.6	2.0	1.5	**4.2**	**2.2**	**3.2**
ASEAN-5	14.1	13.8	8.7	11.8	4.8	6.7	4.7	2.9	**12.1**	**4.8**	**8.4**
Emerging market and developing economies	27.6	45.5	93.7	19.7	7.1	6.6	5.7	4.6	**46.7**	**6.0**	**26.3**
European Union	11.3	6.9	12.2	5.3	2.7	2.3	1.9	1.0	**8.9**	**2.0**	**5.4**
Major advanced economies (G7)	7.9	3.3	3.1	1.8	1.8	2.0	1.7	1.3	**4.0**	**1.7**	**2.9**
World	14.9	16.6	32.7	8.9	4.2	4.3	4.0	3.2	**18.3**	**3.9**	**11.1**

Distribution of average inflation of countries by groups



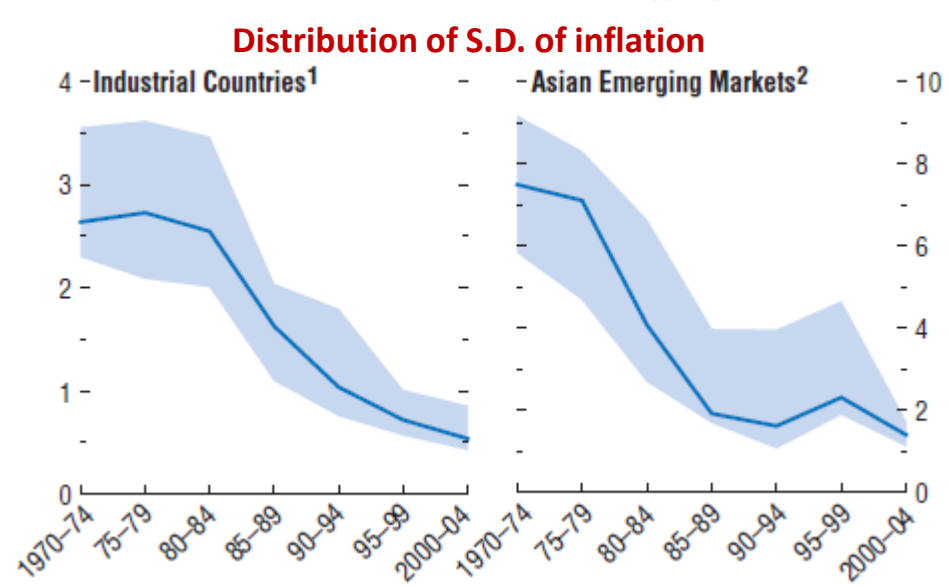
Stylized facts 4 “Along with its declining trend, inflation volatility has reduced too”

Since 2000, most countries have been successful in maintaining the price stability, i.e. *achieving low and stable inflation rate*.

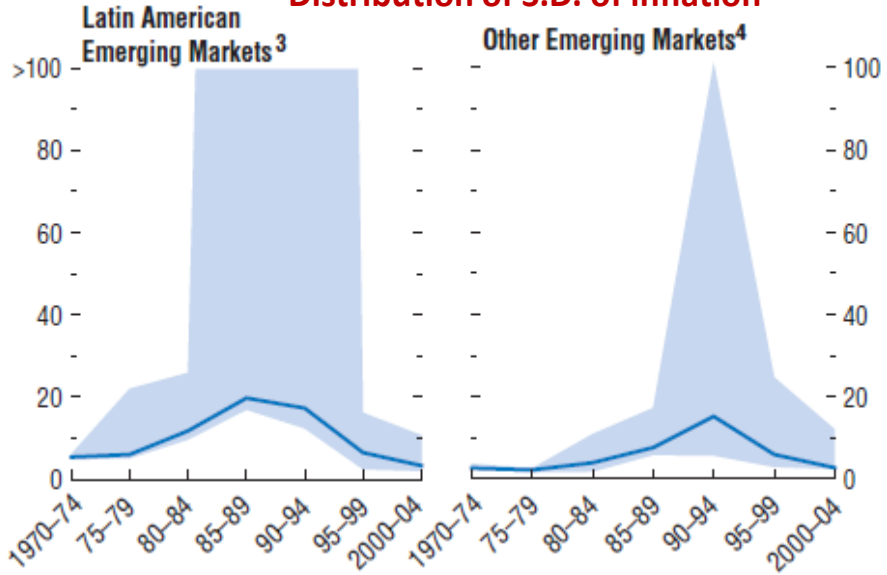
S.D. of inflation of selected countries

Country/Group	before 2000	after 2000	1980-2018
Japan	1.9	0.5	1.8
Thailand	4.3	0.9	3.7
United States	2.9	0.5	2.4
ASEAN-5	5.3	1.0	5.4
Emerging market and developing economies	33.1	0.5	30.9
European Union	6.0	0.3	5.8
Major advanced economies (G7)	2.9	0.4	2.4

Distribution of S.D. of inflation

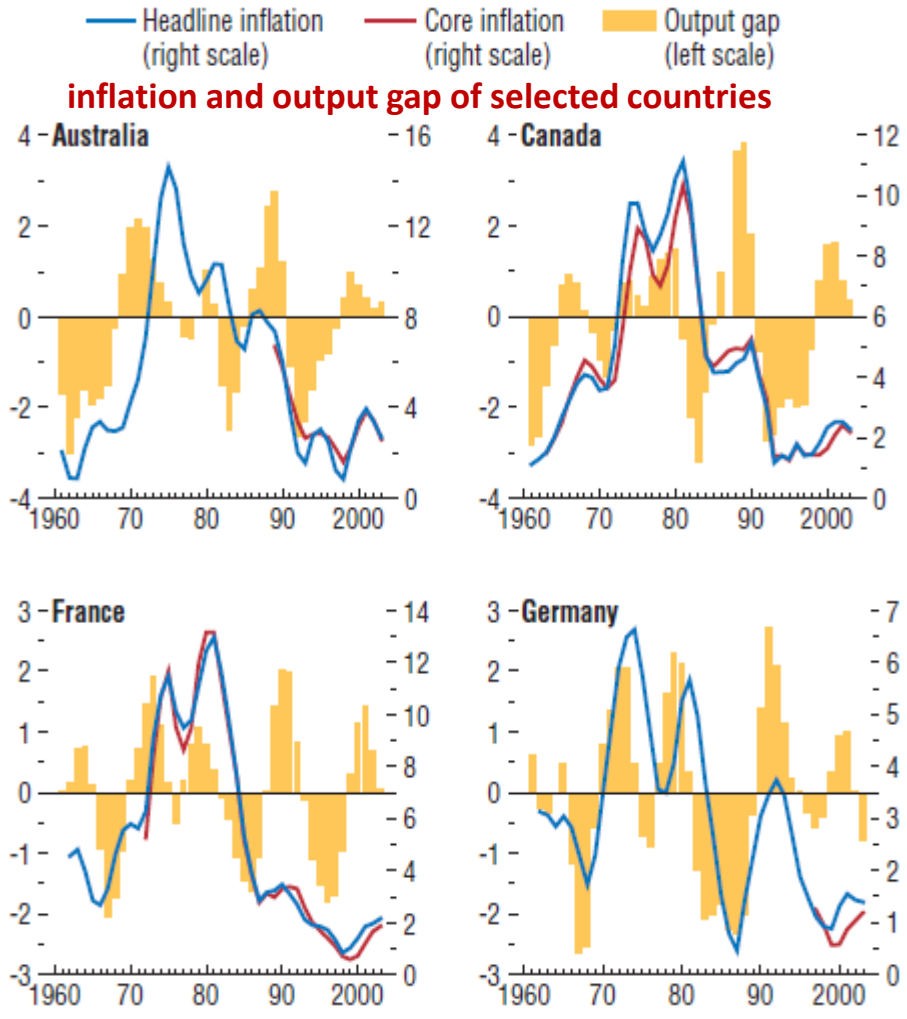


Distribution of S.D. of inflation



Stylized facts 5 "CPI inflation rate exhibits *some cyclical patterns*"

From business cycle perspectives, actual inflation rate moves around (downward) trend, and positively relates to output gap

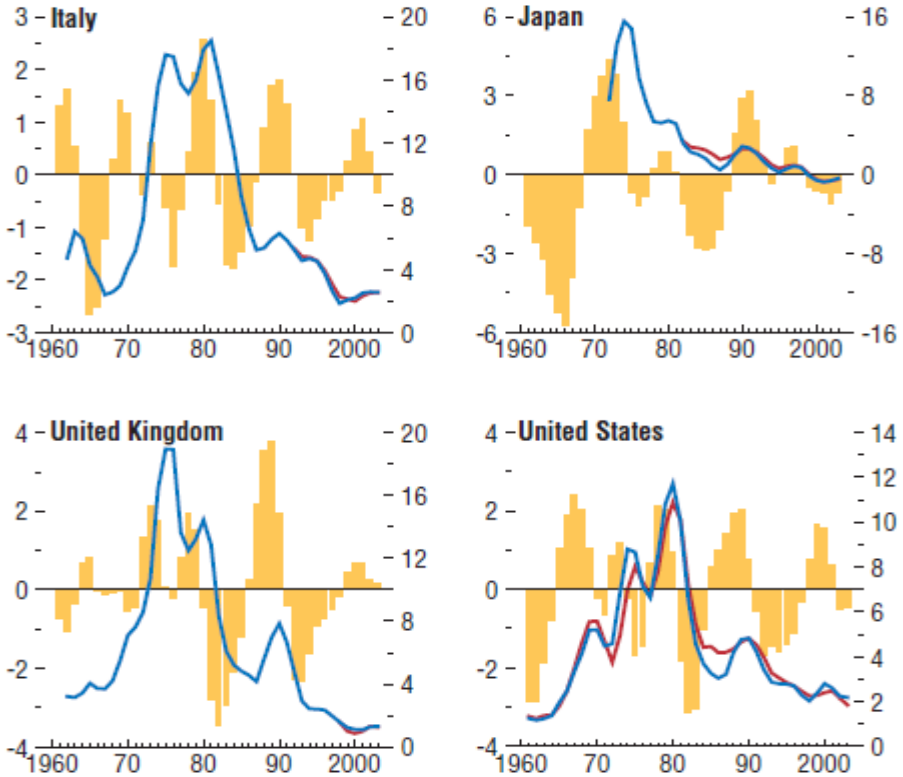


inflation and output gap of selected countries

Table 3.1. Estimates of Output-Inflation Sensitivity and Inflation Persistence in Advanced Economies[1]

Inflation-output elasticity	
1960	0.3
1983	0.3
2004	0.2

inflation and output gap of selected countries



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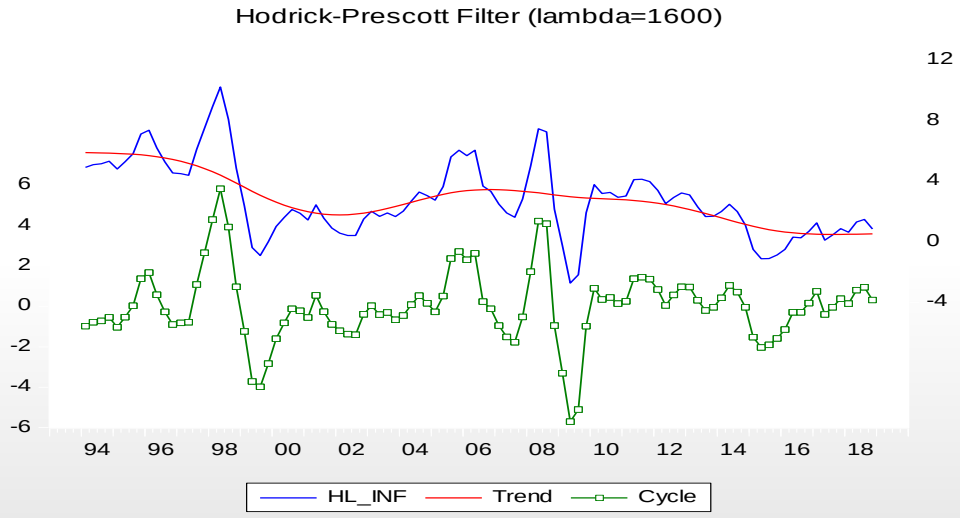
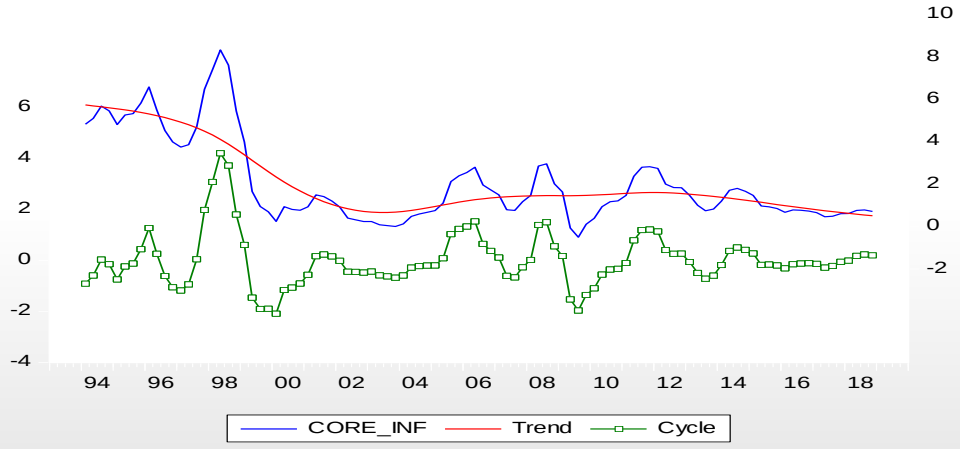




5.1 Core is less volatile than headline

	CORE_INF_CYC	HL_INF_CYC
1993-2018	1.04	1.765
1993-1999	1.66	2.34
2000 - now	0.73	1.55

5.2 Both core and headline inflation are positively correlated.

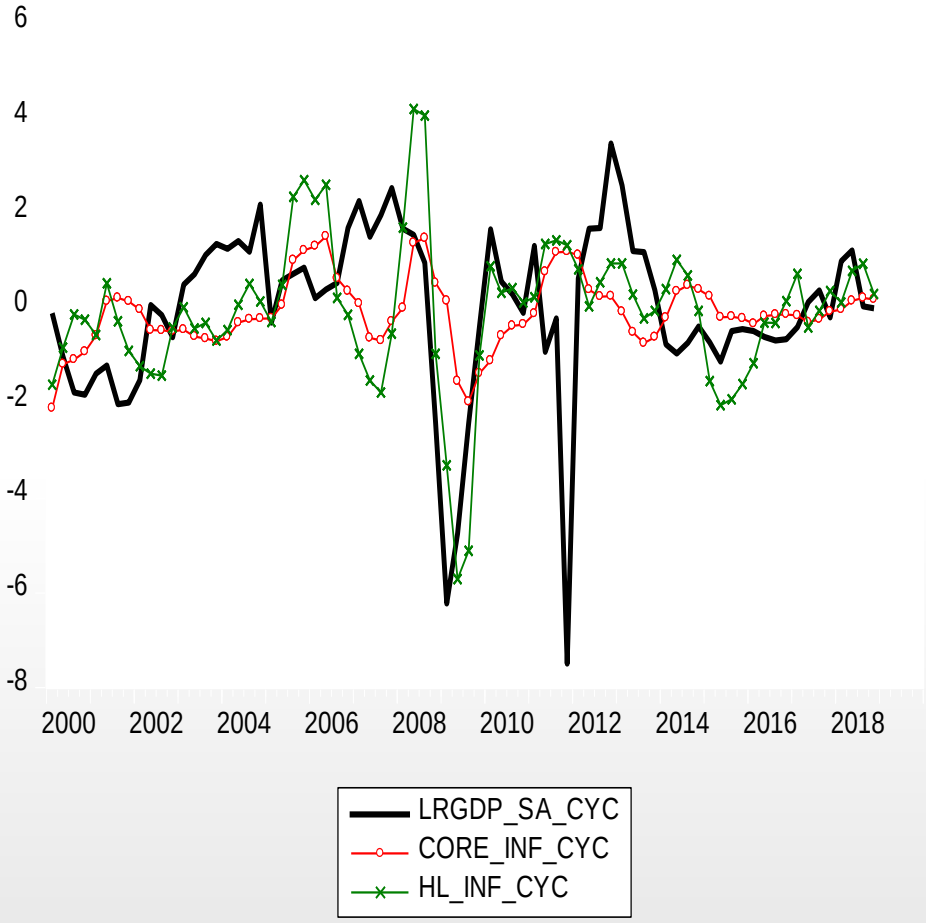
Covariance Analysis: Ordinary
Date: 03/12/19 Time: 22:54
Sample: 2000Q1 2018Q4
Included observations: 76
Balanced sample (listwise missing value deletion)

Correlation Probability	CORE_INF_...	HL_INF_CYC	LRGDP_SA...
CORE_INF_CYC	1.000000 -----		
HL_INF_CYC	0.699870 0.0000	1.000000 -----	
LRGDP_SA_CYC	0.044387 0.7034	0.390608 0.0005	1.000000 -----

Stylized facts 5 "CPI inflation rate exhibits *some cyclical patterns*"

1. From business cycle perspectives, actual inflation rate moves around (downward) trend, and positively relates to output gap.

2. Headline inflation is more cyclically sensitive to output gap than core inflation.



Dependent Variable: HL_INF
Method: Least Squares
Date: 03/13/19 Time: 17:26
Sample (adjusted): 2000Q1 2018Q4
Included observations: 76 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.855629	0.231154	3.701552	0.0004
LRGDP_SA_CYC	0.172464	0.068793	2.506986	0.0146
DUM_2012Q1	-0.593524	0.234432	-2.531759	0.0137
DUM_GFC	-0.102385	0.432224	-0.236878	0.8135
HL_INF(-1)	1.133760	0.128467	8.825325	0.0000
HL_INF(-2)	-0.475238	0.191781	-2.478029	0.0157
HL_INF(-3)	-0.012009	0.184490	-0.065092	0.9483
HL_INF(-4)	0.049713	0.110812	0.448627	0.6551

Dependent Variable: CORE_INF_CYC
Method: Least Squares
Date: 03/13/19 Time: 17:49
Sample (adjusted): 2000Q1 2018Q4
Included observations: 76 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.026072	0.040238	-0.647934	0.5191
LRGDP_SA_CYC	0.059823	0.023961	2.496659	0.0149
CORE_INF_CYC(-1)	1.020801	0.114004	8.954064	0.0000
CORE_INF_CYC(-2)	-0.219503	0.170268	-1.289159	0.2016
CORE_INF_CYC(-3)	0.061212	0.157784	0.387945	0.6992
CORE_INF_CYC(-4)	-0.250139	0.101086	-2.474507	0.0158

Stylized facts: Key Questions?

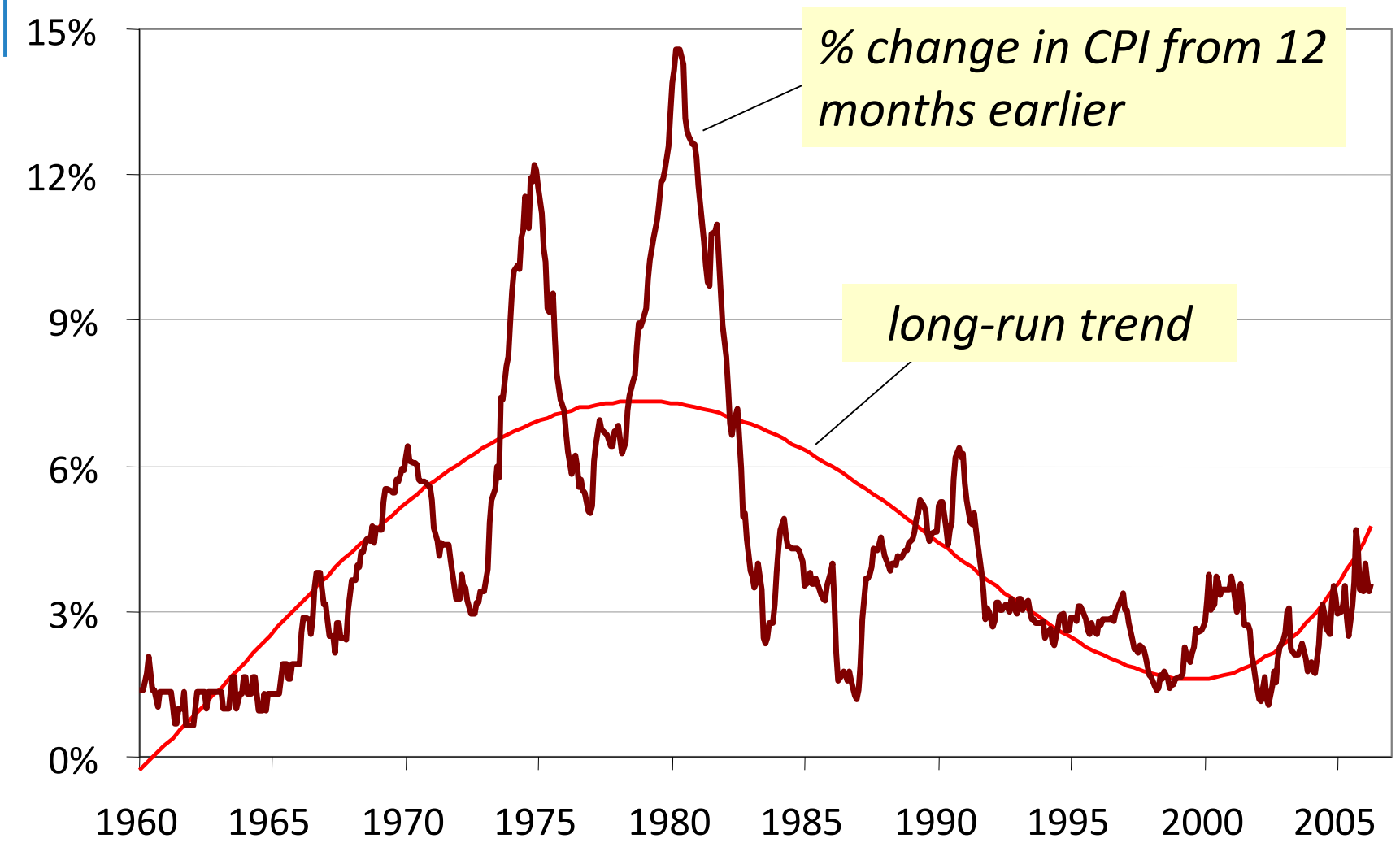
Based on the facts, economists aim to explain the *cause and process of inflation* from two perspectives.

- **Long-run perspective:**
  - What drive the average inflation, i.e. trend of inflation rate? **(Quantity theory of money)**

- **Business cycle perspective:**
  - How to explain the cyclical relationship of inflation? **(Phillips relation)**
  - What explain the moderation in the inflation rate and inflation volatility? **(Good luck/Good policy/Secular factors)**

General theory of inflation: long-run perspective

Trend of inflation



How do economists explain the long-run (sustained) inflation?

In the long-run, economists "strongly" believe that money *growth* drives the "sustained" inflation rate.

- The famous theorem used to explain the average inflation is **the quantity theory of money**

$$M \times V = P \times Q$$

$$\%\Delta M - \%\Delta Q = \%\Delta P$$

- "Inflation is always a **monetary** phenomena. This usually occurs when **money growth is higher than output growth**."

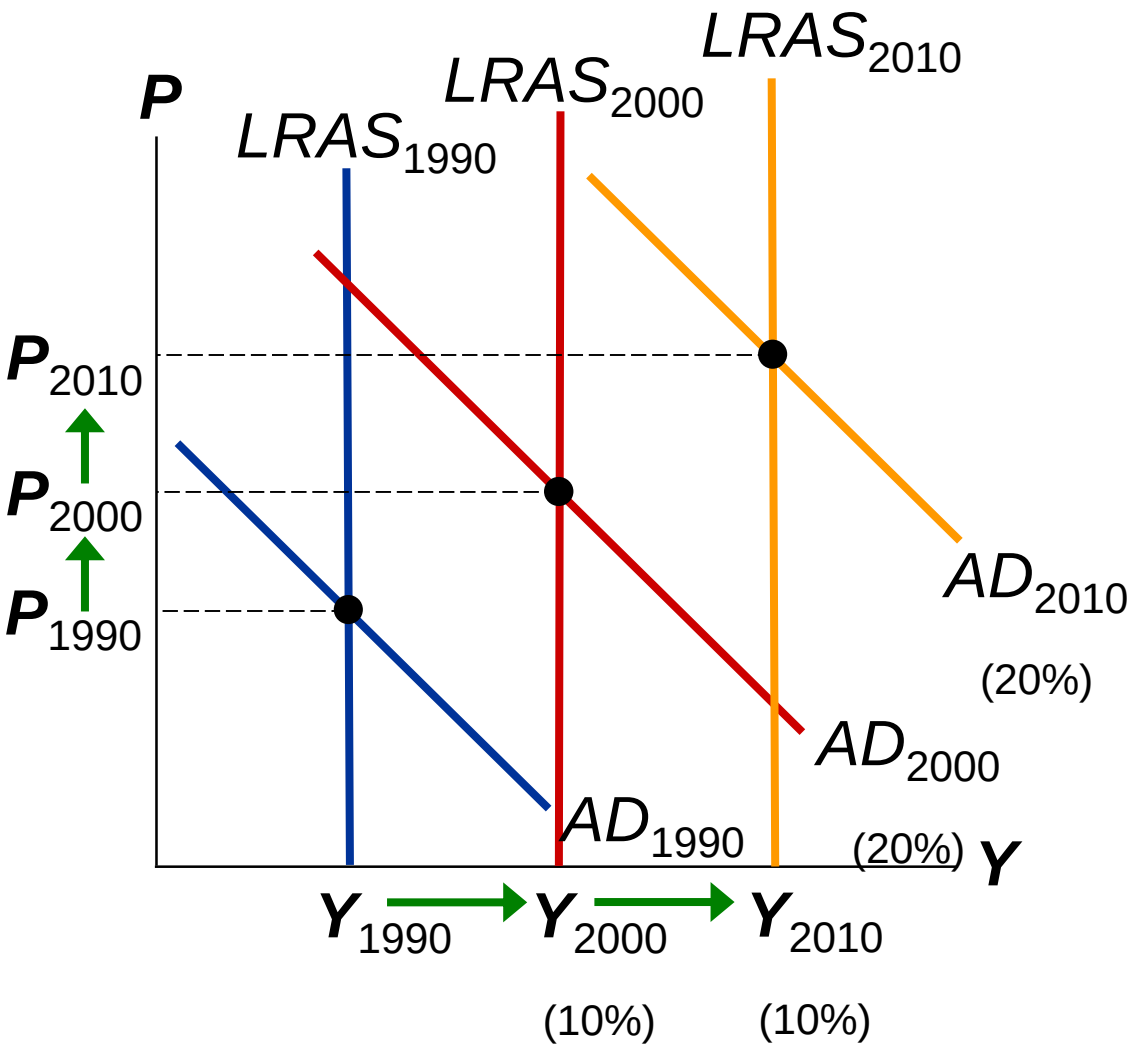
How do economists explain the long-run (sustained) inflation?

Using *AD* & *AS* to depict "long-run" inflation

Over the long run, **tech. progress shifts** *LRAS* to the right (say 10% per decade)

and **growth in the money supply** shifts *AD* to the right (say 20% per decade)

Result:
ongoing inflation and growth in output.



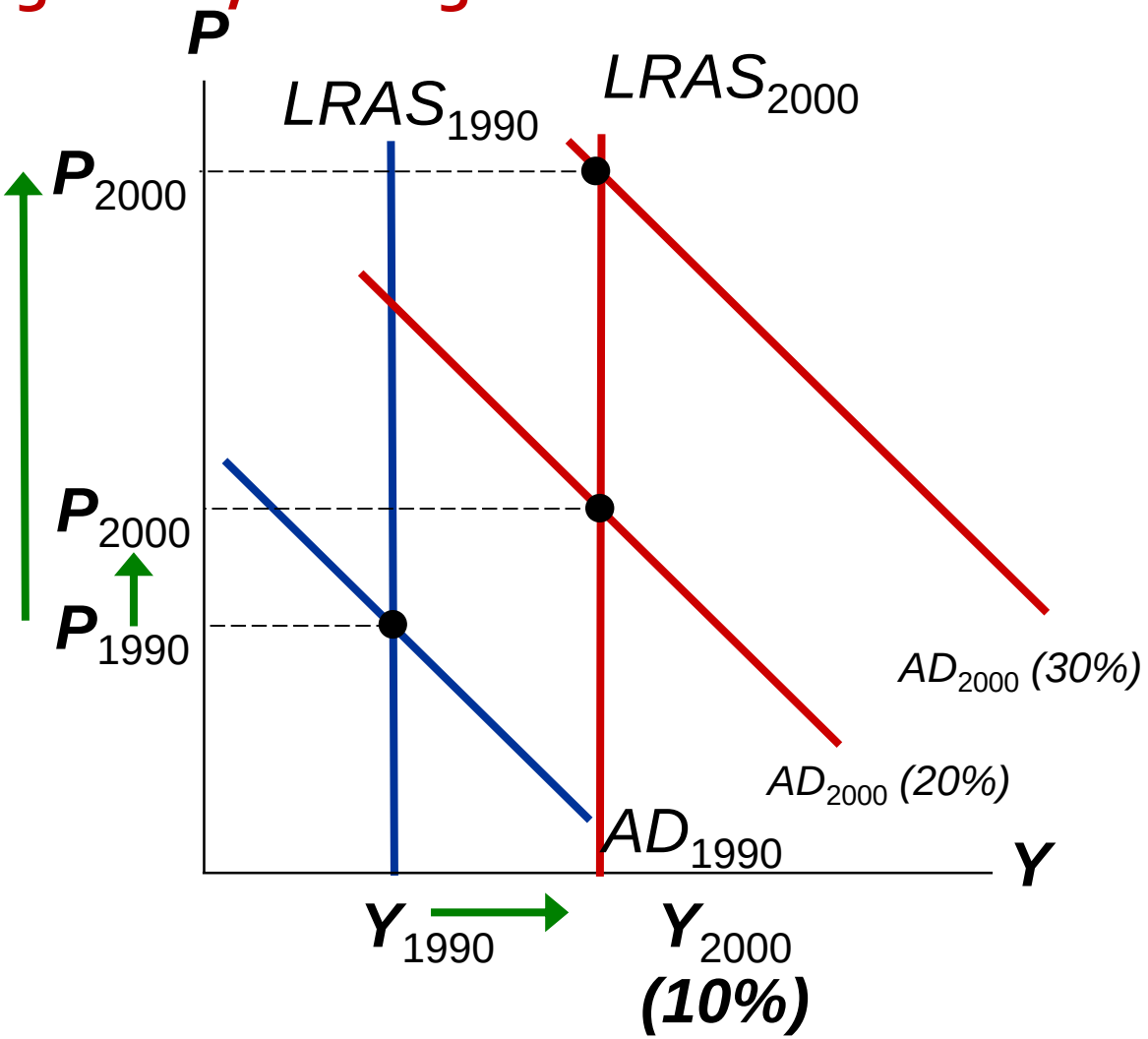
How do economists explain the long-run (sustained) inflation?

The higher money growth, the higher inflation rate!

Higher money growth (20% → 30%) shifts AD to the right further

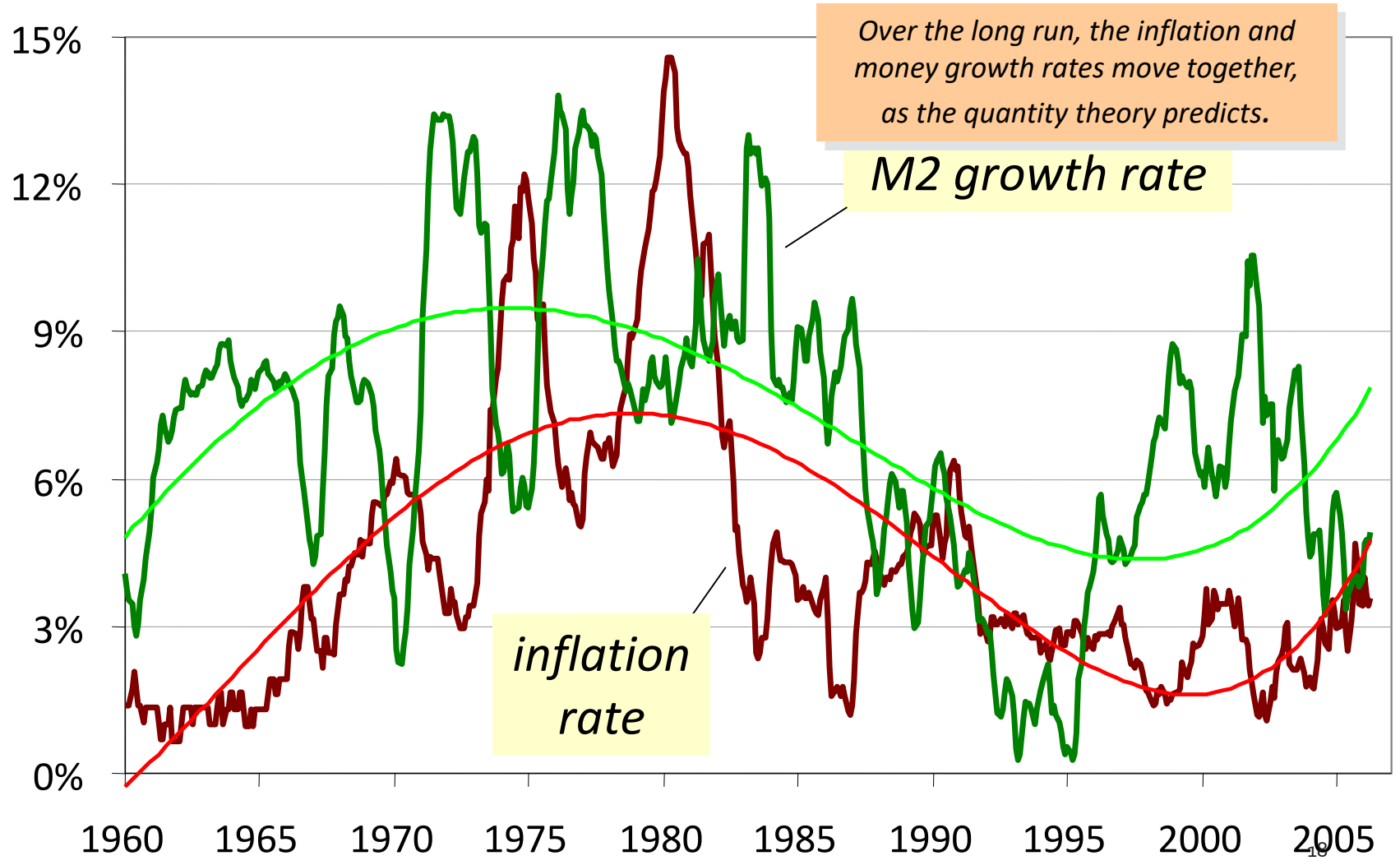
Result:

"Higher" long-term inflation



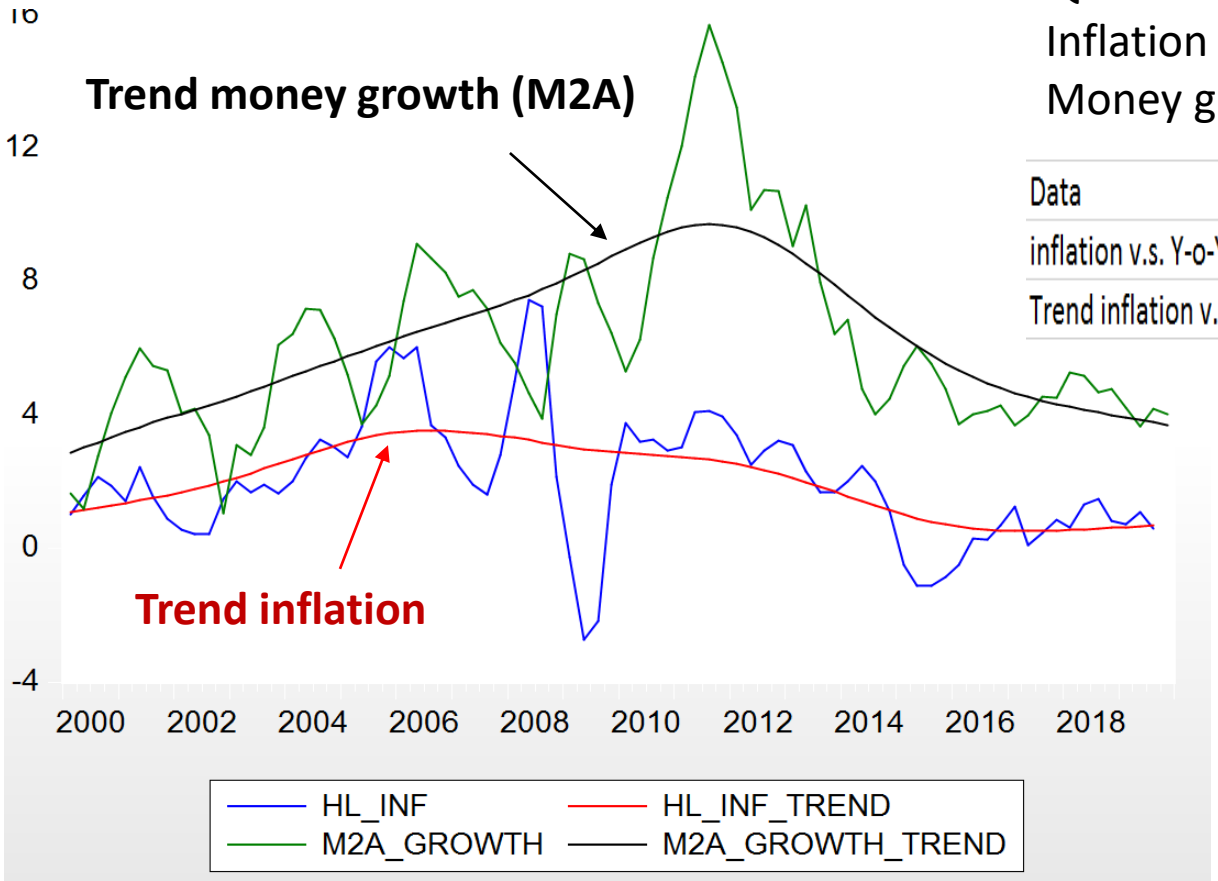
How well does the theory explain facts?

U.S. INFLATION AND MONEY GROWTH, 1960-2006



How well does the theory explain facts?

THAI INFLATION AND MONEY GROWTH, 2000-2019



Quarterly data

Inflation = Y-o-Y headline CPI

Money growth = Y-o-Y M2A

Data	Correlation	p-value
inflation v.s. Y-o-Y M2a	0.283953	0.011
Trend inflation v.s. Trend M2A growth	0.574705	0

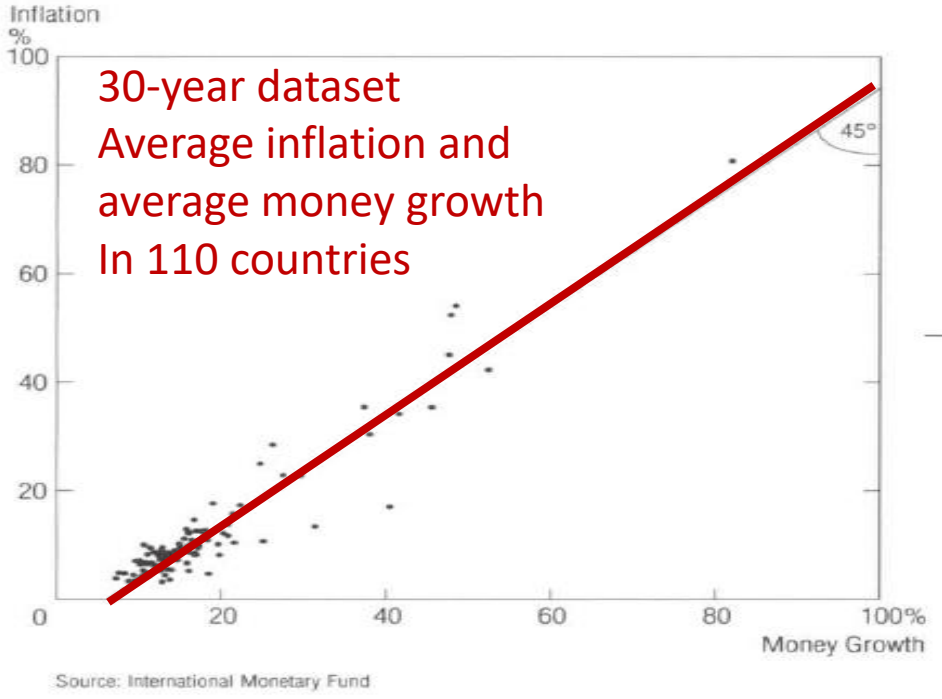
How well does the theory explain facts?

For long horizon data, many studies with cross-country comparison confirm the validity of the quantity theory; higher average money growth = higher average inflation

Chart 1

Money Growth and Inflation:
A High, Positive Correlation

Average Annual Rates of Growth in M2 and in Consumer Prices During 1960–90 in 110 Countries



Source: International Monetary Fund

Table 1

Correlation Coefficients for Money Growth and Inflation*

Based on Data From 1960 to 1990

Sample	Coefficient for Each Definition of Money M0	M1	M2
All 110 Countries	.925	.958	.950
Subsamples			
21 OECD Countries	.894	.940	.958
14 Latin American Countries	.973	.992	.993

*Inflation is defined as changes in a measure of consumer prices.
Source of basic data: International Monetary Fund

- Money growth **positively correlates** with inflation rate
- The finding is **robust!**

General theory of inflation: business cycle perspective and inflation dynamic

Business cycle perspective and inflation dynamic

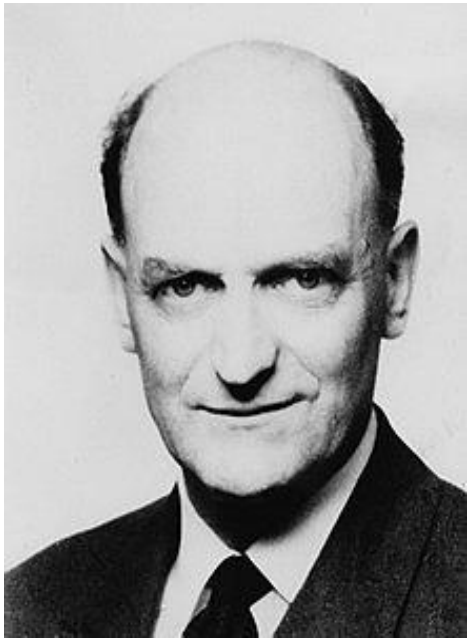
Inflation dynamic concerns with the movement of inflation rate over the course of business cycles

- The famous theorem widely cited to explain the inflation dynamic is the **Phillips relation**
  - Negative relation between inflation and unemployment

- The relation was **one of the most controversial issues** in economics
  - Is the negative relation (trade-off concept) stable?
  - Policy implications?

A brief history of theory of inflation dynamic

Phillips relation: comovement between inflation and "real economic activities". The relation was first mentioned in 1958 by A.W. Phillips

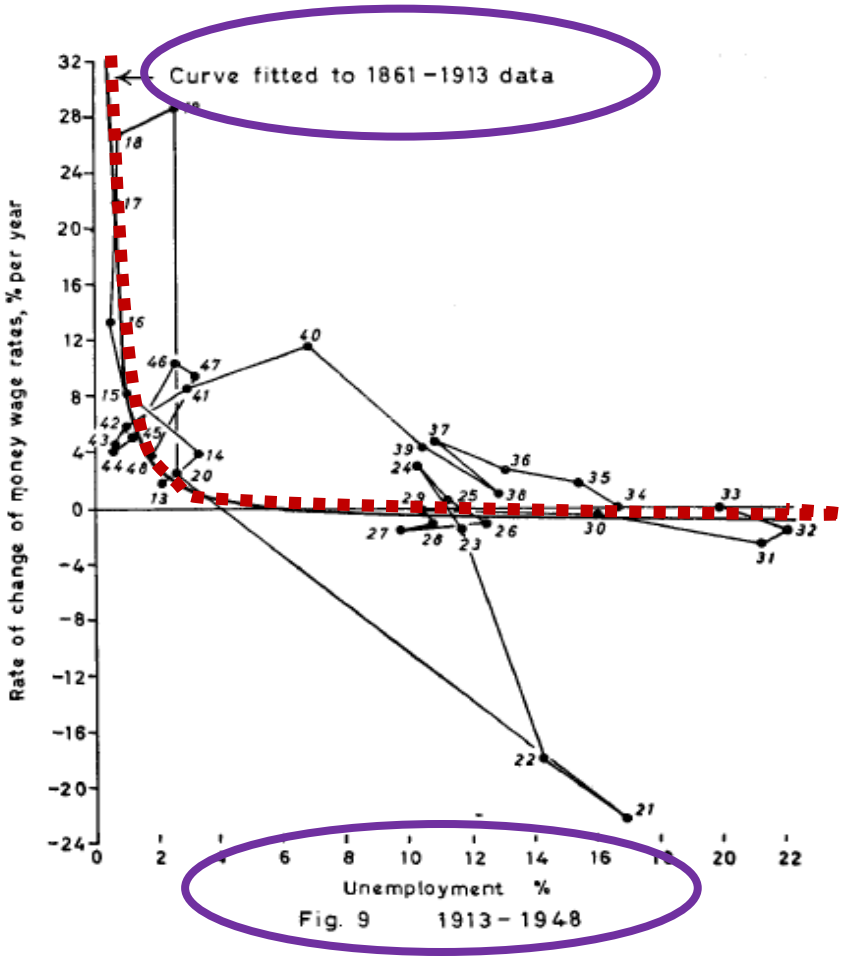


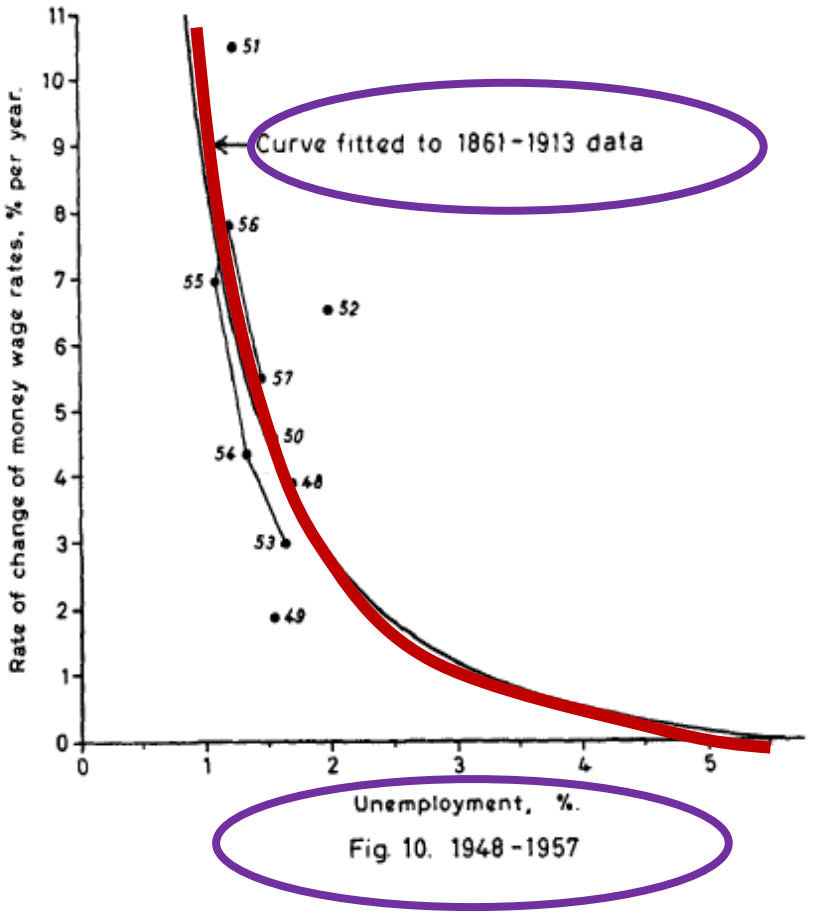
Alban William Phillips (1914-1975), the London School of Economics.

- He discovered the inverse relationship between the **rate of unemployment** and the **rate of increase in money wages**
  - ***Wage* inflation** decreases with **unemployment rate**
- Studies based on the UK data for 1861-1957
  - The relation **has been highly stable**

A brief history of theory of inflation dynamic

What do we mean by the highly stable relation?
>>High predictive (forecasting) performance





Source: Phillips (1958)

A brief history of theory of inflation dynamic

The name '*Phillips curve*'

- 1960 Paul Samuelson and Robert Solow found a similar relation in the US data for 1900-1960.
  - To give the credit to Phillips, the relation is dubbed '**the Phillips curve**'.
- Subsequently, economists uncovered a similar relation when looking into the comovement between the **CPI inflation** and the **unemployment rate**.

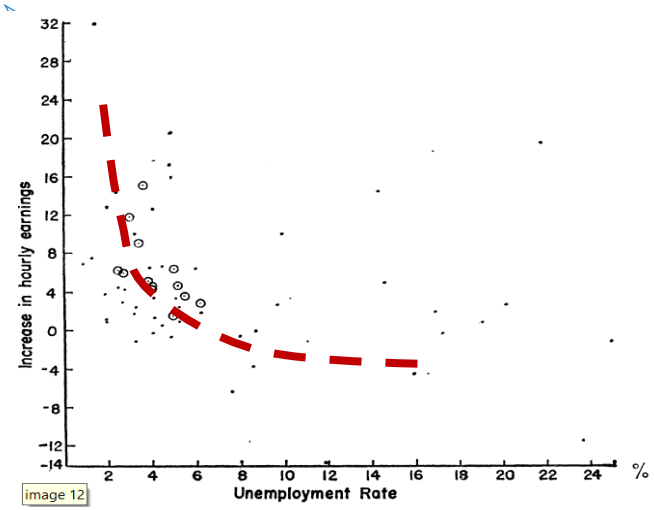


image 12

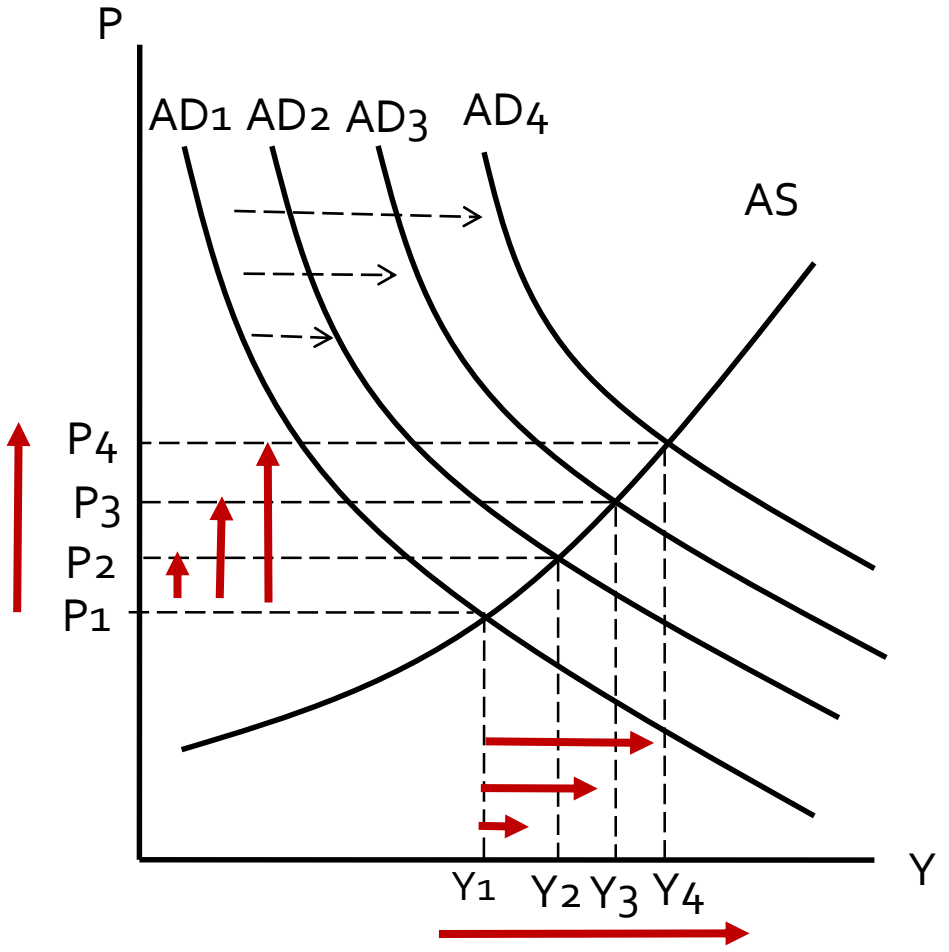
FIGURE 2

MODIFIED PHILLIPS CURVE FOR U.S.

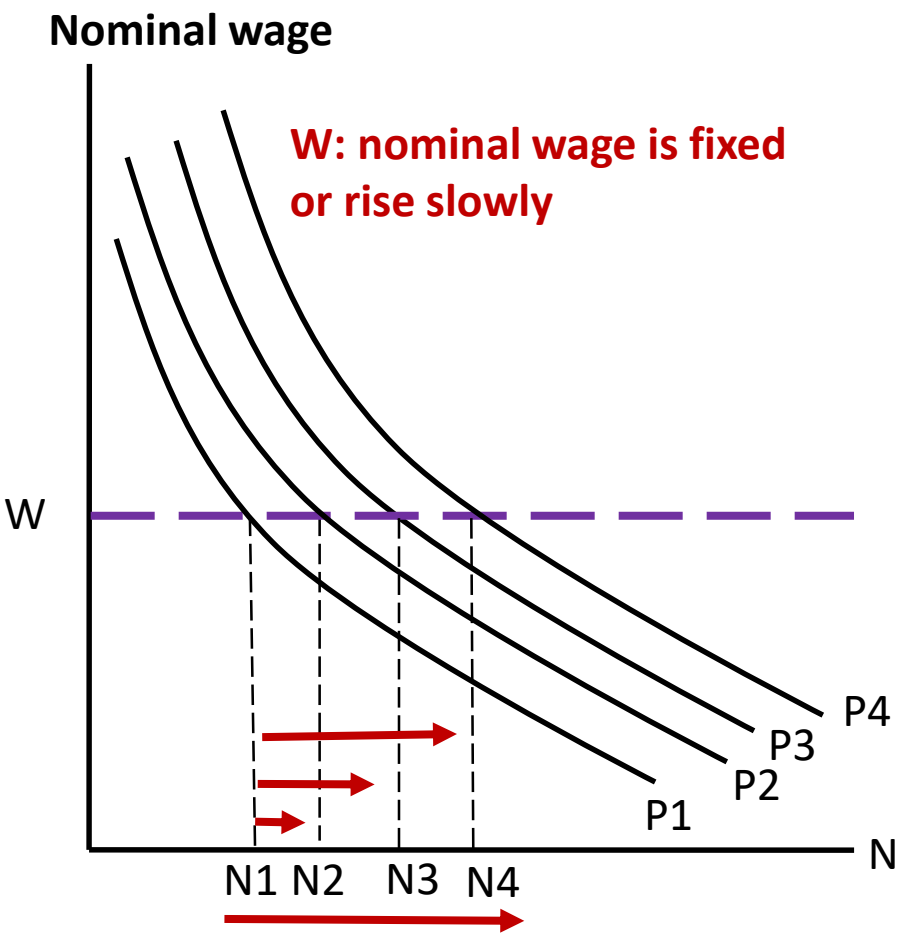
This shows the menu of choice between different degrees of unemployment and price stability, as roughly estimated from last twenty-five years of American data.

Early explanation: Keynesian interpretation

Keynesian's economist interpreted the Phillips relation using the *nominal rigidities concept*; demand-pull effect



lower unemployment rate; higher rate of increase in price



Higher employment; lower unemployment rate

How important was the discovery of Philips relation?

The discovery greatly influenced the thinking paradigm of many policymakers; they became more interventionist.

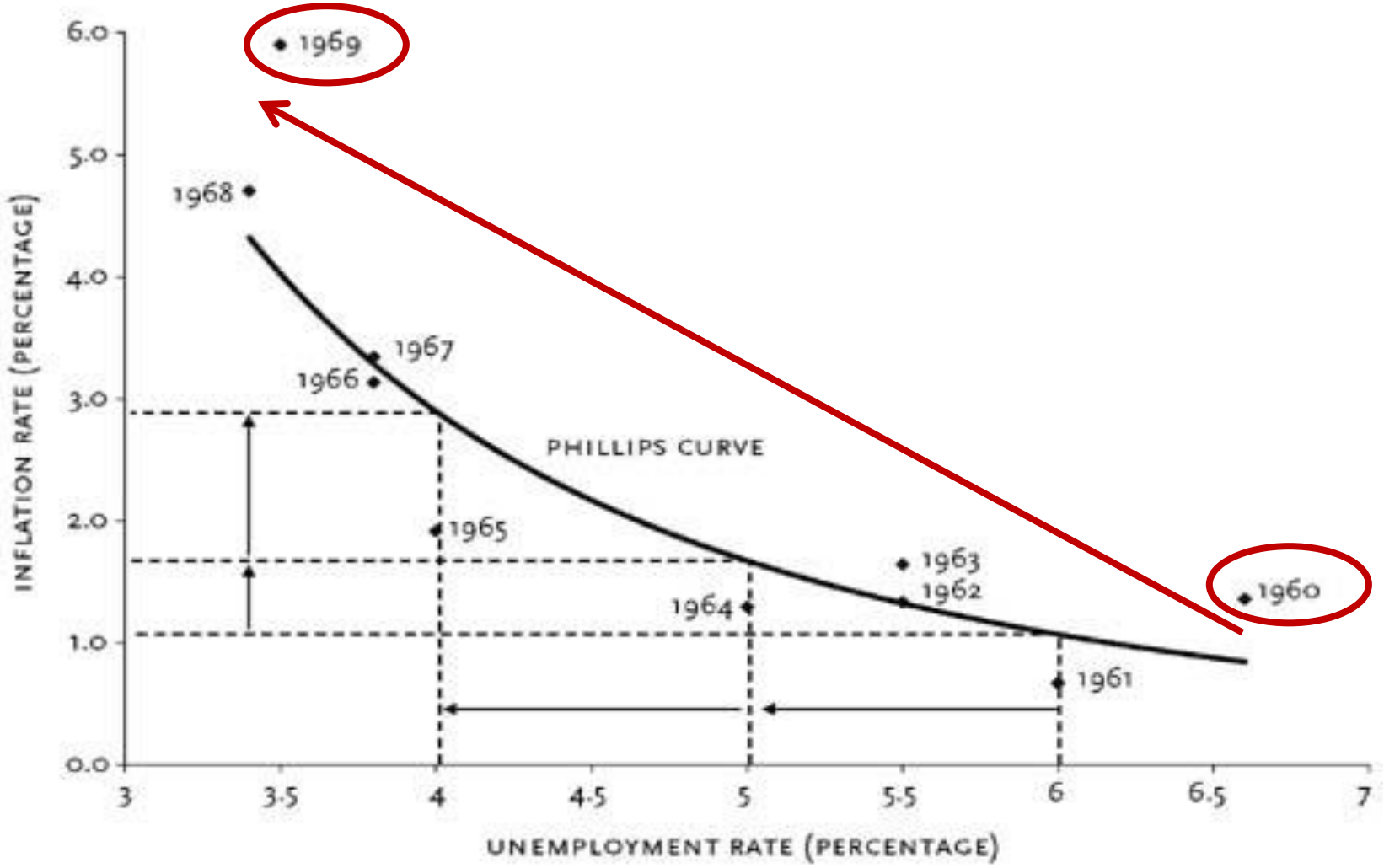
- Because of the negative relationship, economists, as well as policymakers, believed in the ***trade-off*** *between inflation and unemployment*
  - Higher unemployment → Lower inflation
  - Lower unemployment → Higher inflation

- The trade-off was believed to be ***permanent*****, and therefore *could be exploited***

- Policymakers can choose between different **combinations of inflation and unemployment**, based on **preferences**.
  - (observed) Outcomes determined by **preference**.

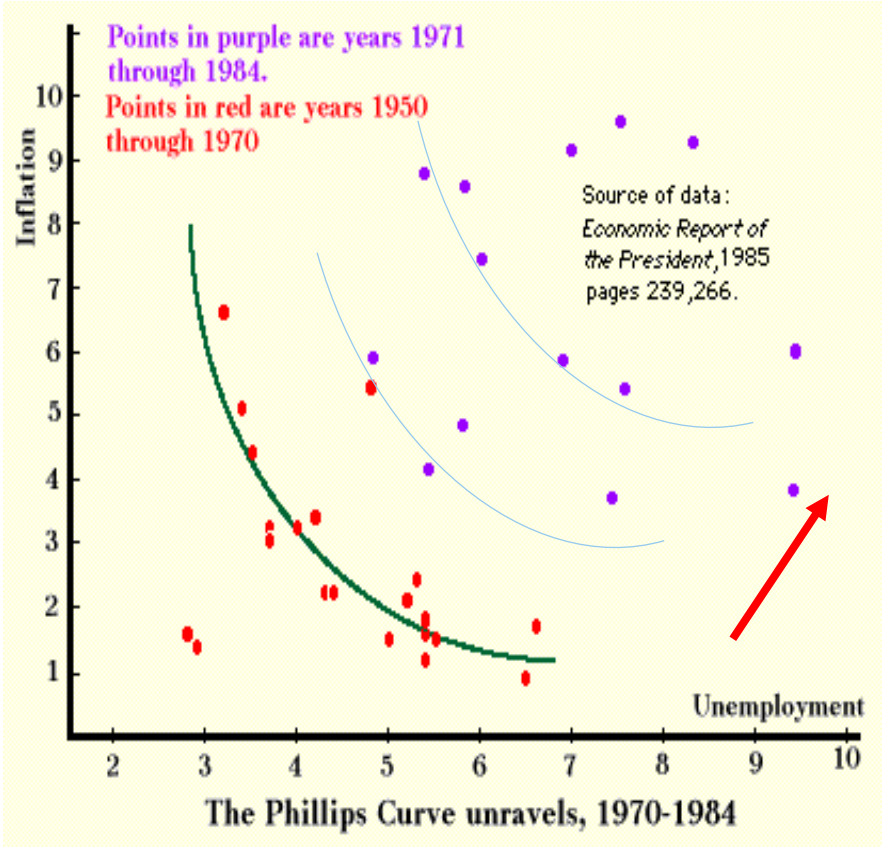
How important was the discovery of Philips relation?

During the 1960s, policymakers *exploited* the trade-off, and pursued aggressive expansionary policy, i.e. pro-growth policy



The breakdown of Philips curve: Oil shocks

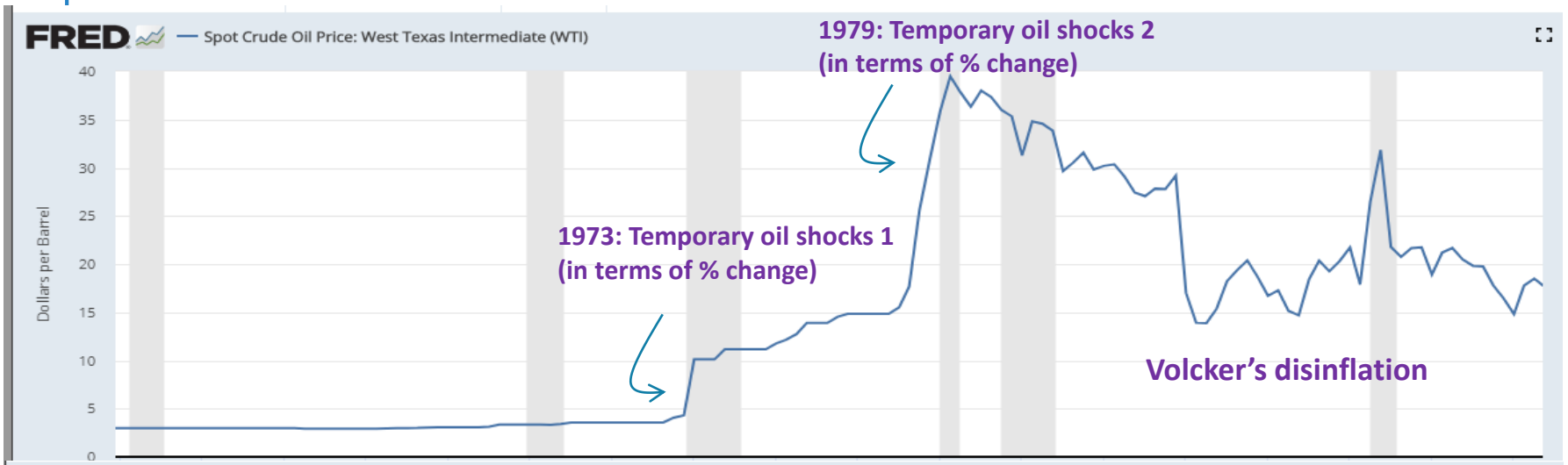
1970s was a good test for the Phillips curve; unfortunately, Phillips relation had seemed to have a wreckage at the first place!

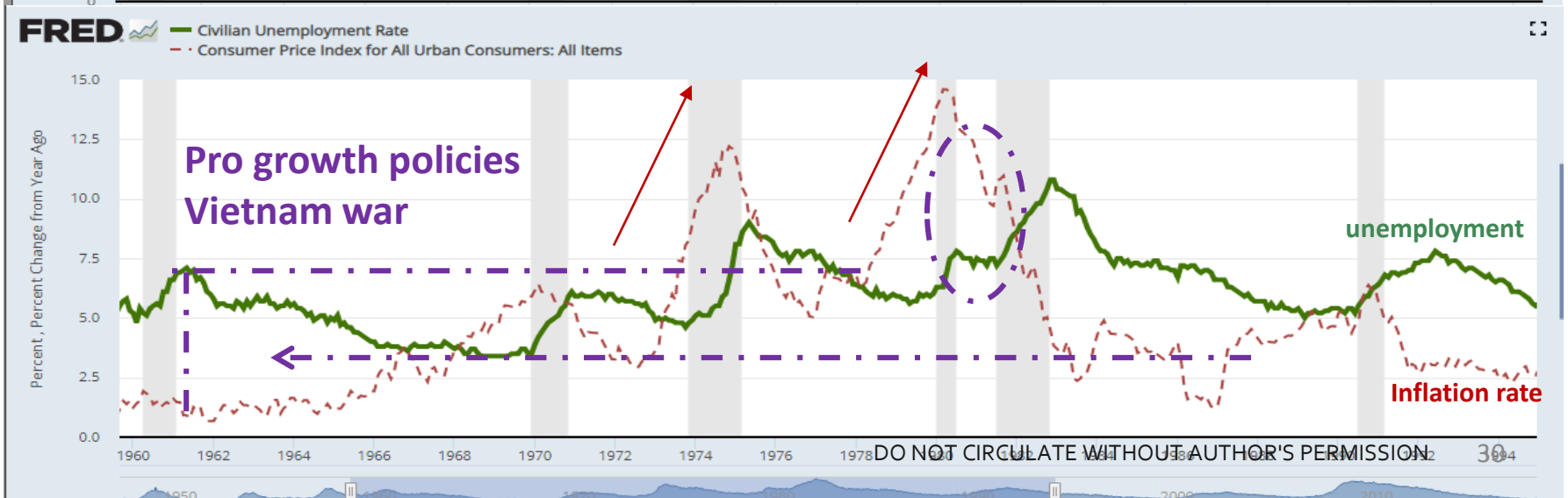


- High inflation and high unemployment --- **stagflation**.
  - Oil price hikes by the OPEC.
  - Inflation rises and high unemployment
- Shouldn't this be obvious? The Stagflation?
  - Phillips curve Shift up by **negative supply shocks!**
- But then, why break down?
  - Why didn't the inflation rate come back to the original after the shocks were over!

The breakdown of Philips curve: Puzzle?

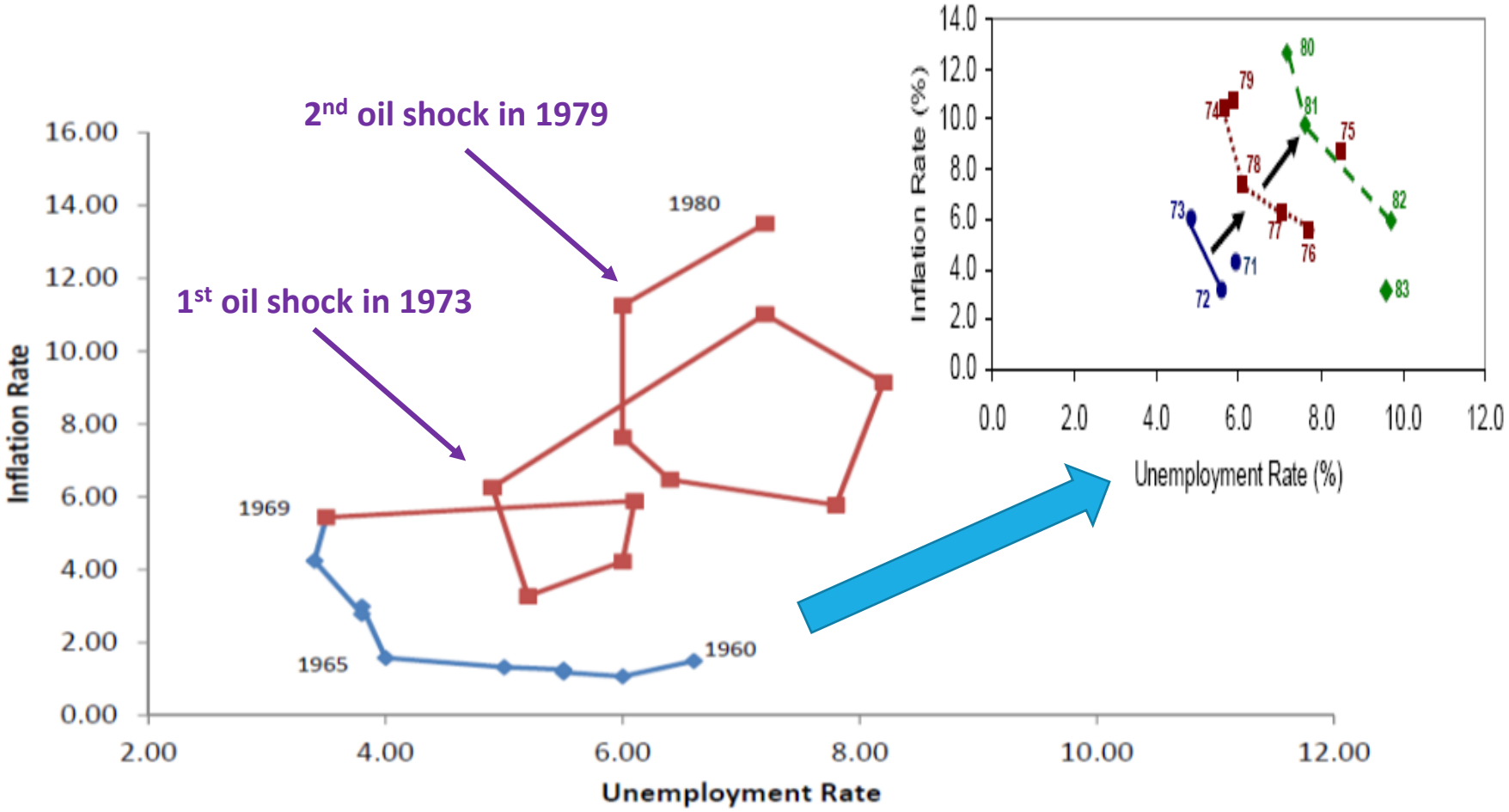
Why the inflation rate did not come down even the oil price had reached its new stable high with no further increase, and the recession had been over.





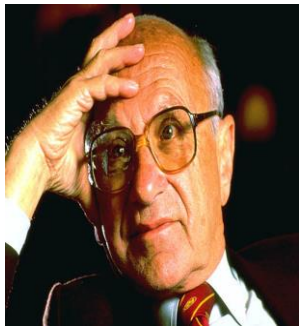
The breakdown of Philips curve: Accelerating inflation spiral

Why inflation rate <u>did not come down</u> even the oil price had reached its new stable high with no further increase, and the recession had been over.



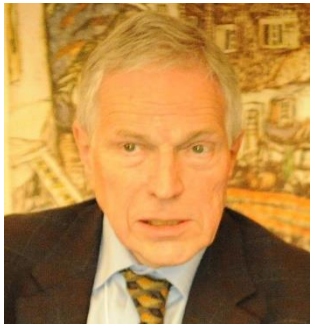
Explanation: the rise of expectation-augmented Philips curve

Accelerating inflation spiral during the 1970s was the outcome of (i) supply shocks, and (ii) the overlooked effect of inflation expectation that had put the inflation rate remained high after the shocks



Milton Friedman (1912-2006), University of Chicago

Nobel Prize 1976.



Edmund S. Phelps, Jr. (b1933), Columbia University

Nobel Prize 2006.

- The ***accelerating of inflation*** during 70s was the result of the *misconception* on the knowledge of inflation dynamic
- Friedman and Phelps argued for the role of the **natural rate of unemployment *and* inflation expectation** as additional factors that importantly explain the evolution of inflation dynamic
  - Key overlooked ingredient **inflation expectation, and they way it is formed and has *evolved* over time**
- Given their economics reasoning, **while there is a trade-off in the short-run, the trade-off does not exist in the long run.**

The expectation-augmented Philips curve: relation and derivation

Inflation, unemployment, and the Phillips curve: The modern concept on expectation-augmented Phillips curve

The **Phillips curve** states that π depends on

- expected inflation, $E\pi$
- **cyclical unemployment**: the deviation of the actual rate of unemployment from the natural rate
- supply shocks, ν (Greek letter "nu").

$$\pi = E\pi - \beta(u - u^n) + \nu$$

where $\beta > 0$ is an exogenous constant.

The expectation-augmented Philips curve: derivation 1

Deriving the Phillips curve from *SRAS*

(1) $Y = \bar{Y} + \alpha(P - EP)$

(2) $P = EP + (1/\alpha)(Y - \bar{Y})$

(3) $P = EP + (1/\alpha)(Y - \bar{Y}) + v$

(4) $(P - P_{-1}) = (EP - P_{-1}) + (1/\alpha)(Y - \bar{Y}) + v$

(5) $\pi = E\pi + (1/\alpha)(Y - \bar{Y}) + v$

(6) $(1/\alpha)(Y - \bar{Y}) = -\beta(u - u^n)$

(7) $\pi = E\pi - \beta(u - u^n) + v$

The expectation-augmented Philips curve: derivation 2

Comparing *SRAS* and the Phillips curve

SRAS: $Y = \bar{Y} + \alpha(P - EP)$

Phillips curve: $\pi = E\pi - \beta(u - u^n) + \nu$

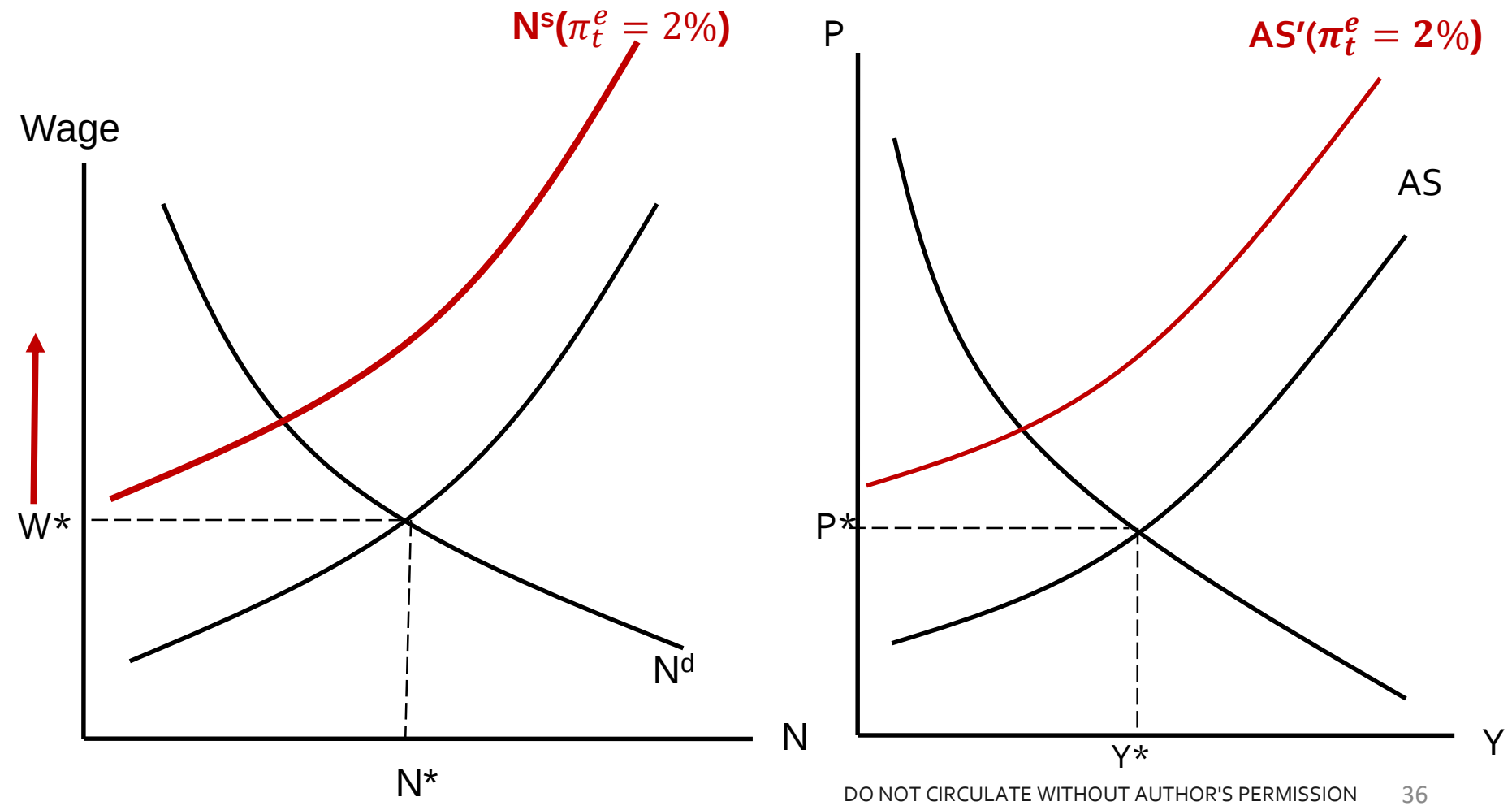
- *SRAS* curve: Output is related to **unexpected movements in the price level.**

- Phillips curve: Unemployment is related to **unexpected movements in the inflation rate.**

The expectation-augmented Philips curve: Intuition 1

1. Suppose we started from the natural level (N*,y*)

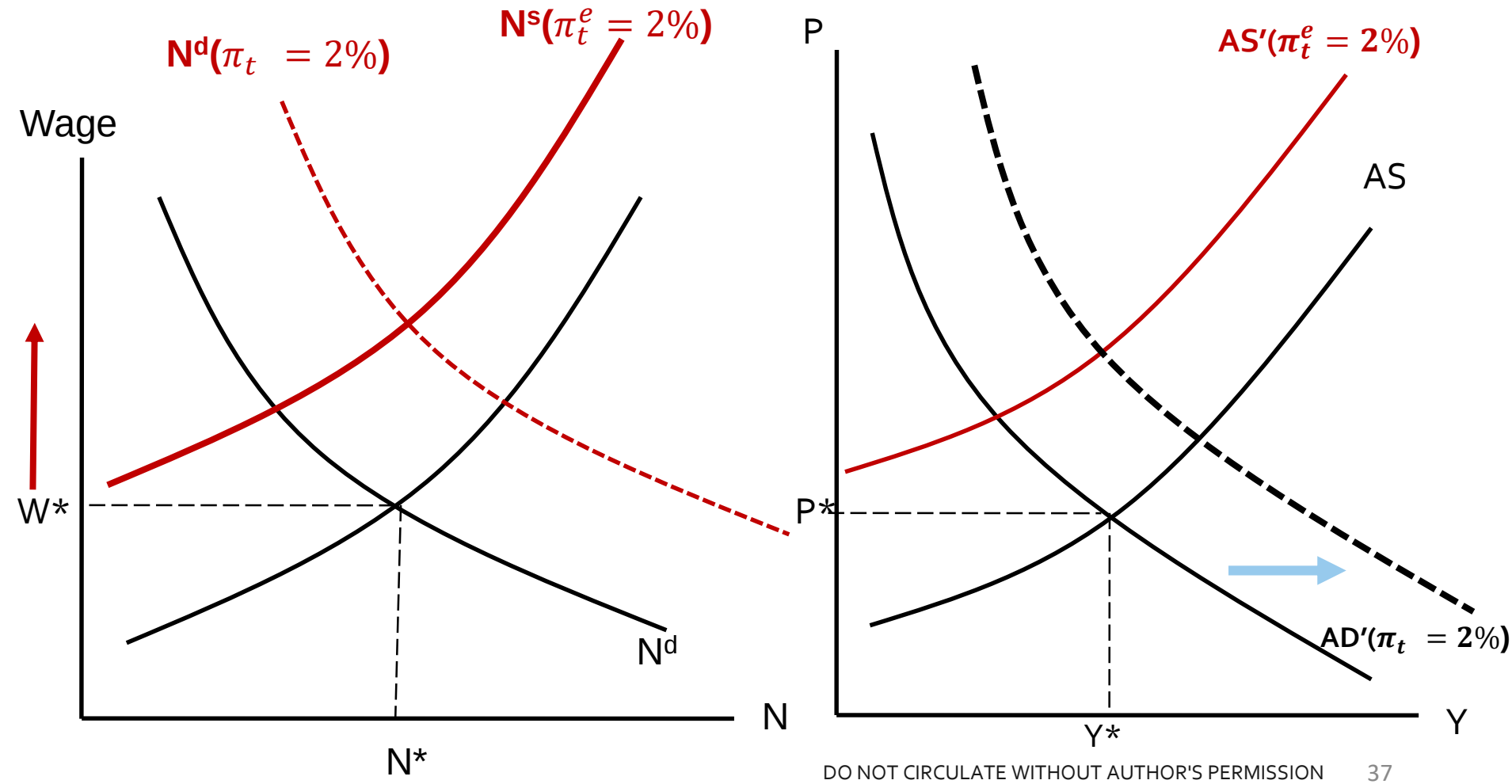
2. Assume that workers expected a 2% inflation rate, and incorporated the expectation into the wage-setting and labor supply decision



The expectation-augmented Philips curve: Intuition 2

3. Suppose aggregate demand growth ensures that the actual level of inflation is 2%.

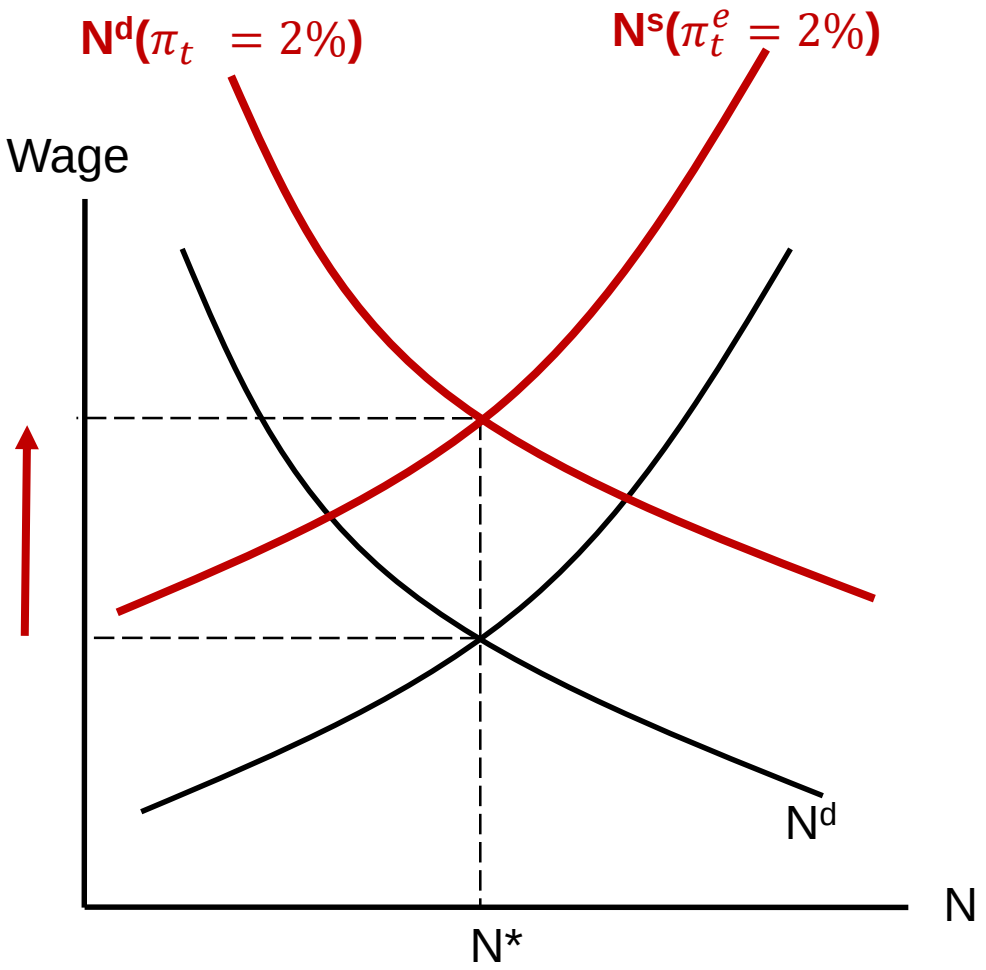
4. 2% increase in price will increase demand for labor; real wage is kept the same, and hence the level of employment and output fixed at the potential level



The expectation-augmented Philips curve: Intuition 3

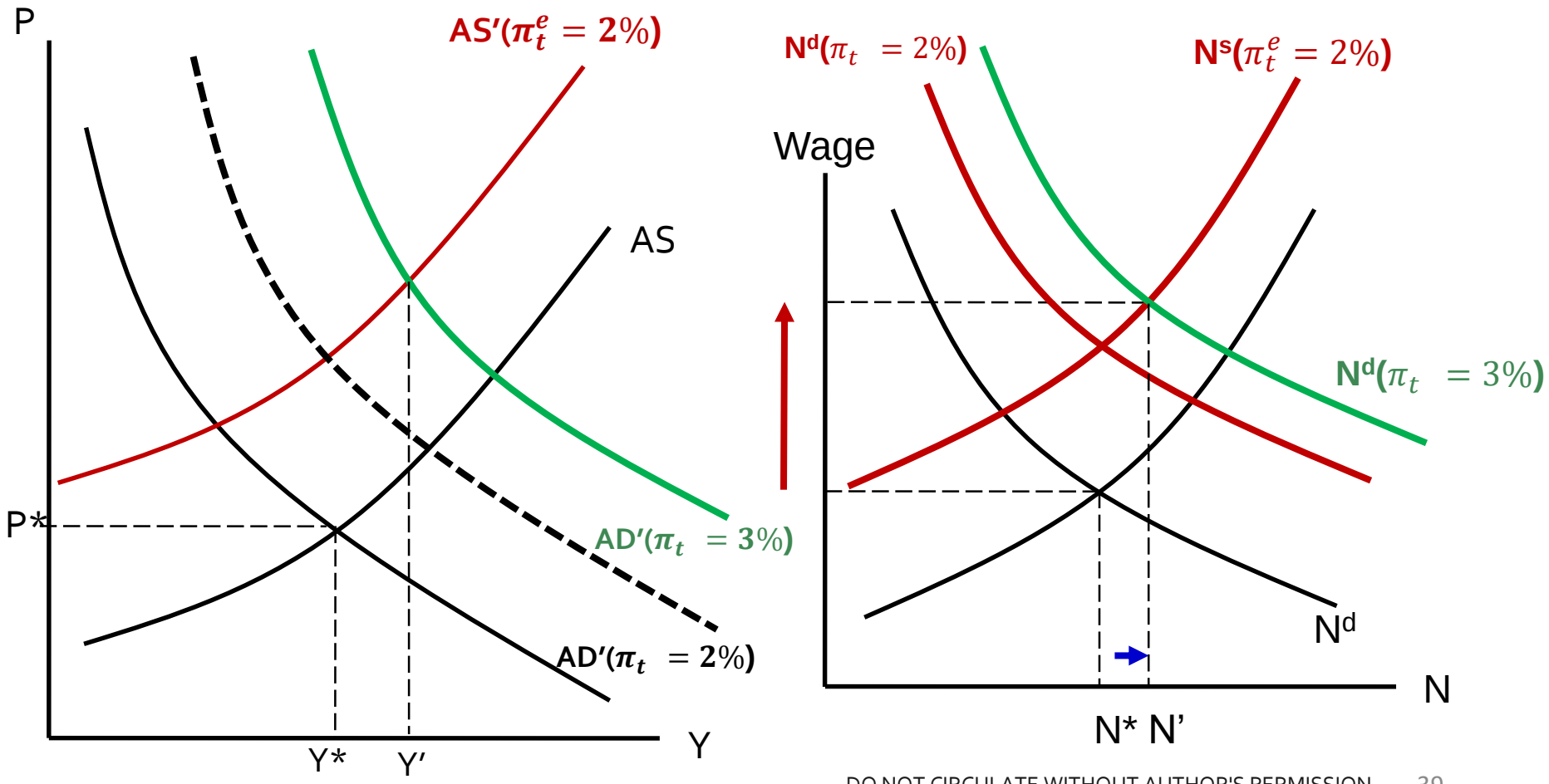
Assume that workers expected a 2% inflation rate, and incorporated the expectation into the wage-setting and labor supply decision

- For simplicity, suppose the original real wage is equal to "1" and the economy was operating at the natural rate of unemployment.
- With 2% expected inflation, workers should require for more pay, at least equal to 2%
- Recall that higher price will result in higher demand for labor; if the actual inflation is also 2% , demand for labor will increase to sufficiently result in a proportionate increase in nominal wage.
- Economy will continue to produce at the original N*, i.e. natural rate of unemployment



The expectation-augmented Philips curve: Intuition 4

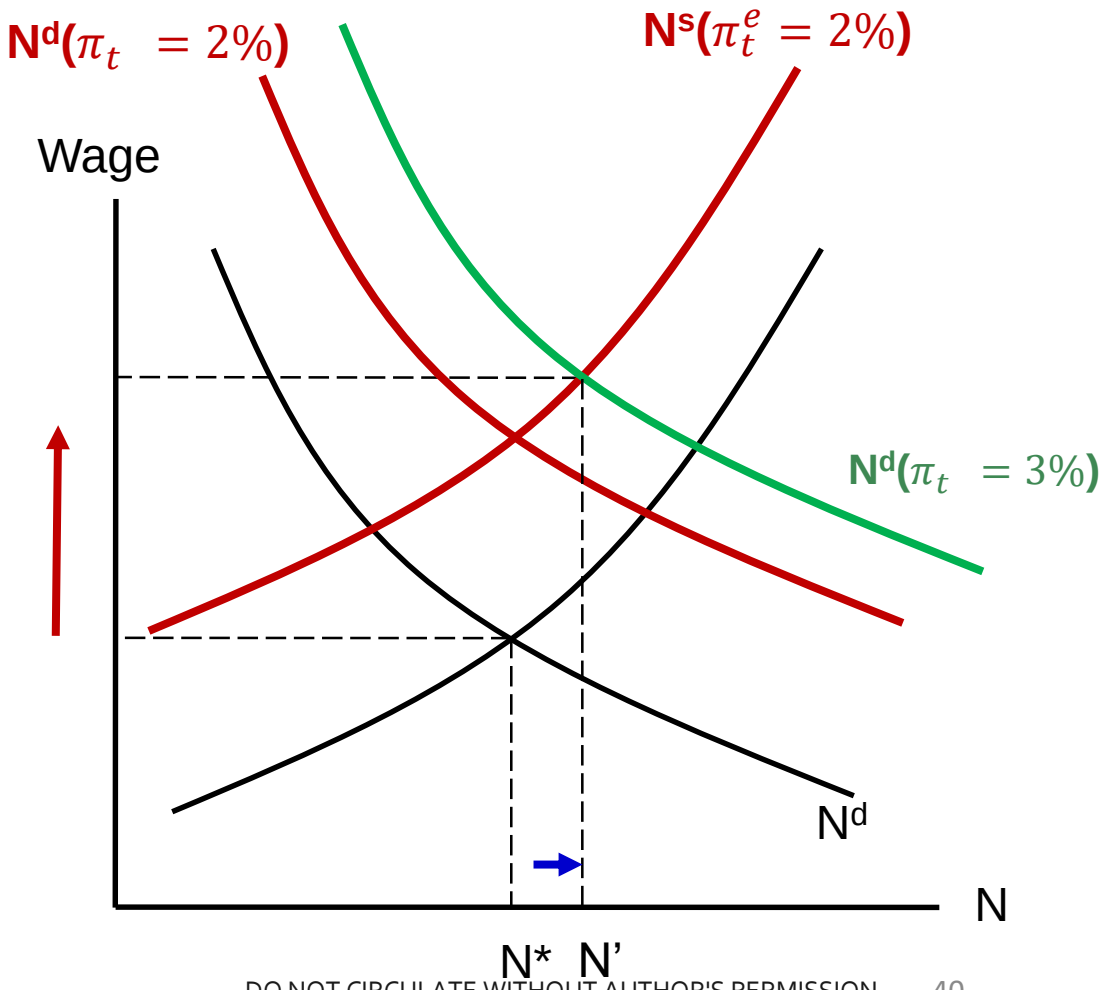
Now suppose inflation is expected to be 2%, but aggregate demand turns out to grow more than expected; this causes actual inflation to rise above 2% (say 3%)



The expectation-augmented Philips curve: Intuition 5

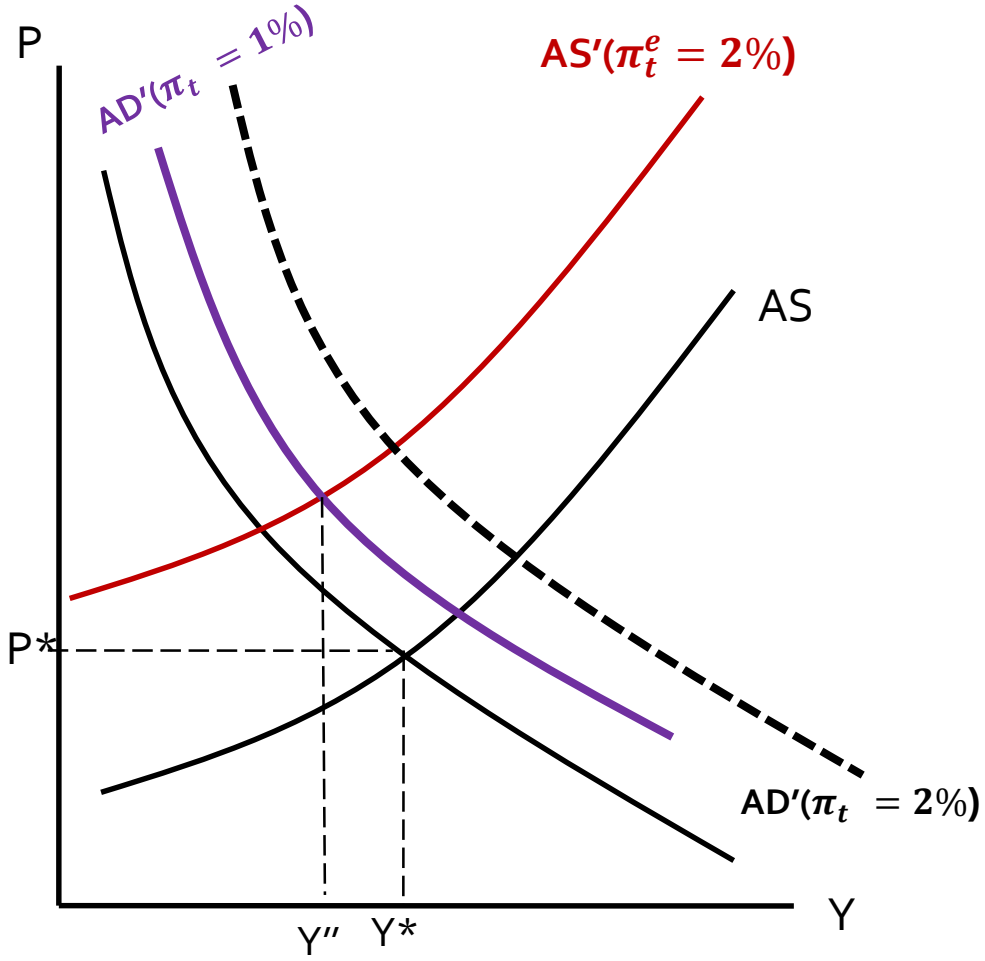
Providing fixed 2% inflation expectation, when actual inflation is above the expected inflation, the economy would have the overemployment.

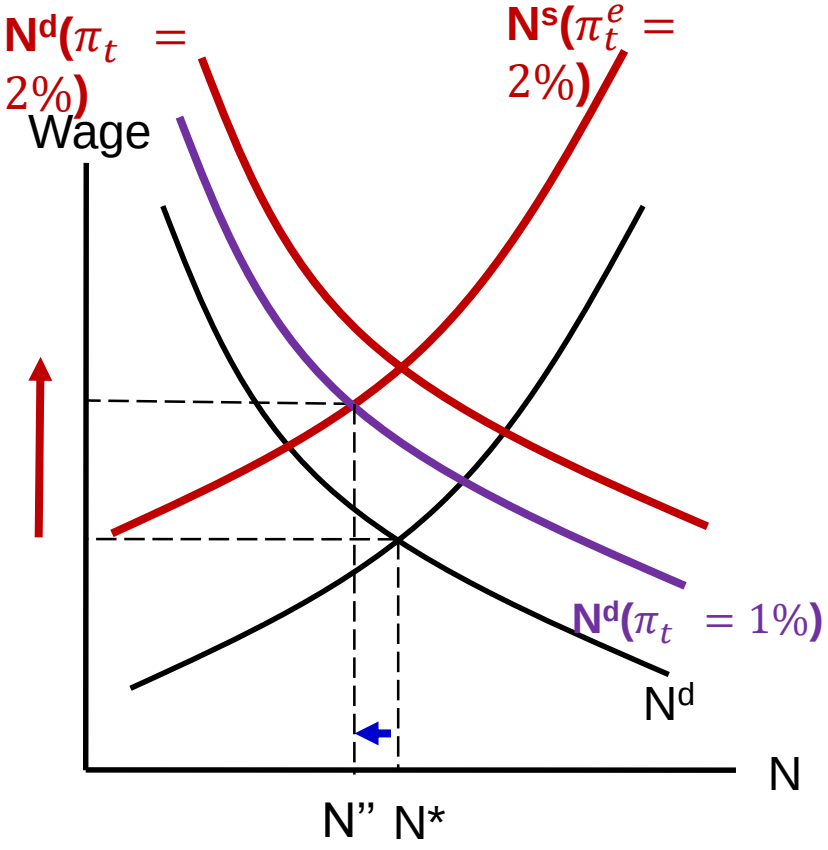
- However, if aggregate demand grows more than expected, causing actual inflation to be 3%, what would happen then?
  - Workers were lead to believe that inflation will be 2%; they should have asked for an even more higher pay if they had known about this
  - Real wage is lower than expected.
  - Overemployment: $u_t < u_t^n$ when $\pi_t > \pi_t^e$



The expectation-augmented Philips curve: Intuition 6

Now suppose inflation is expected to be 2%, but aggregate demand turns out to grow less than expected; this causes actual inflation to rise above 2% (say 1%)

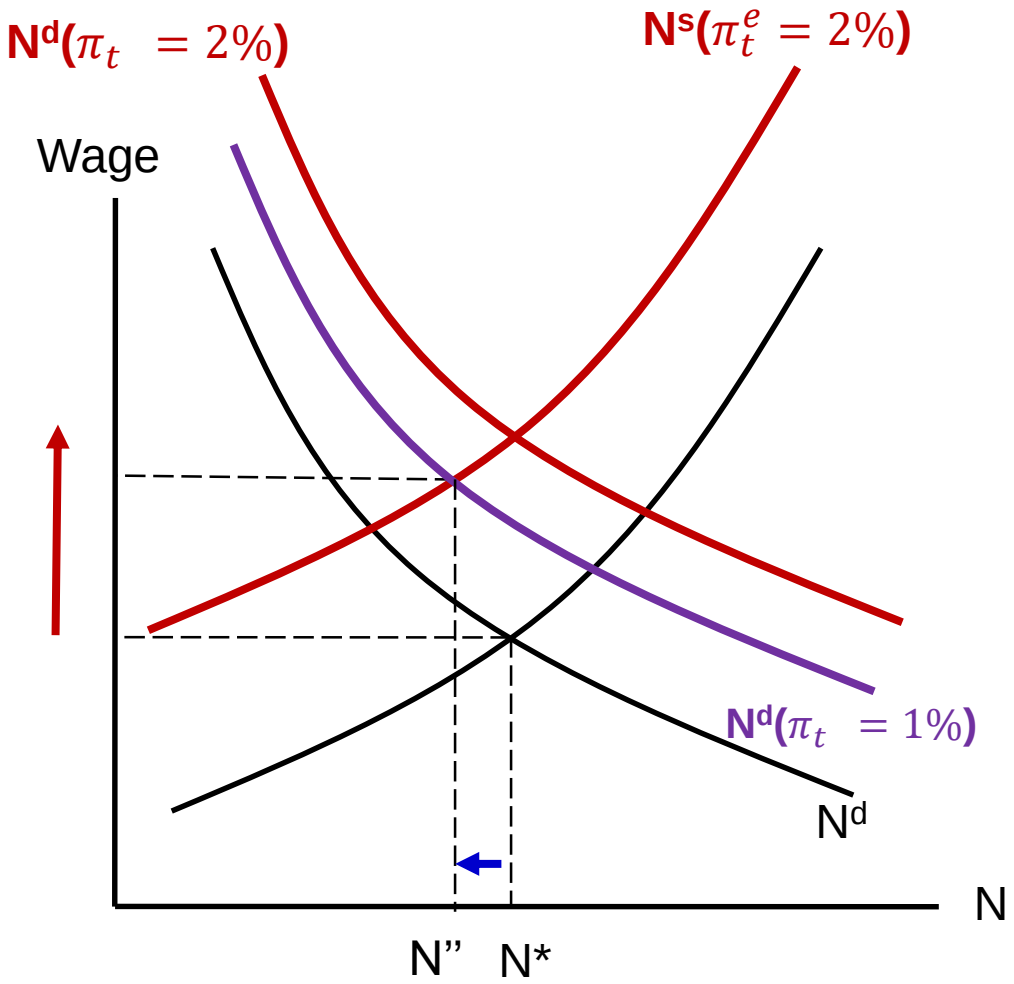




The expectation-augmented Philips curve: Intuition 7

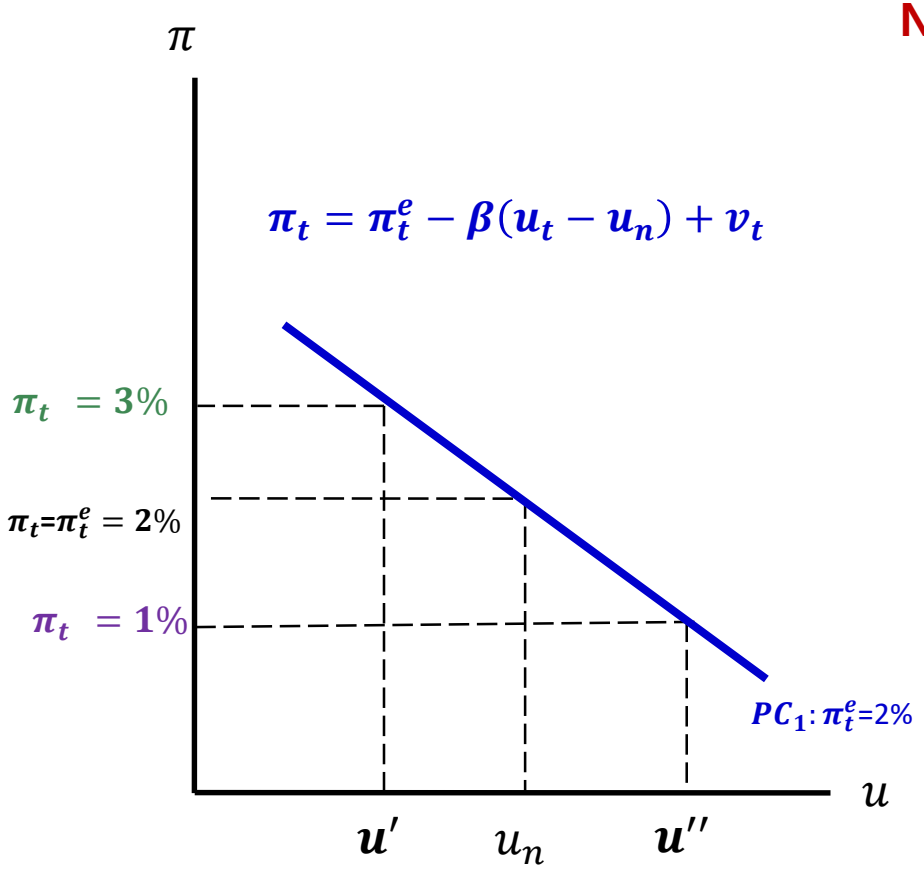
Assume that workers expected a 2% inflation rate, and incorporated the expectation into the wage-setting and labor supply decision

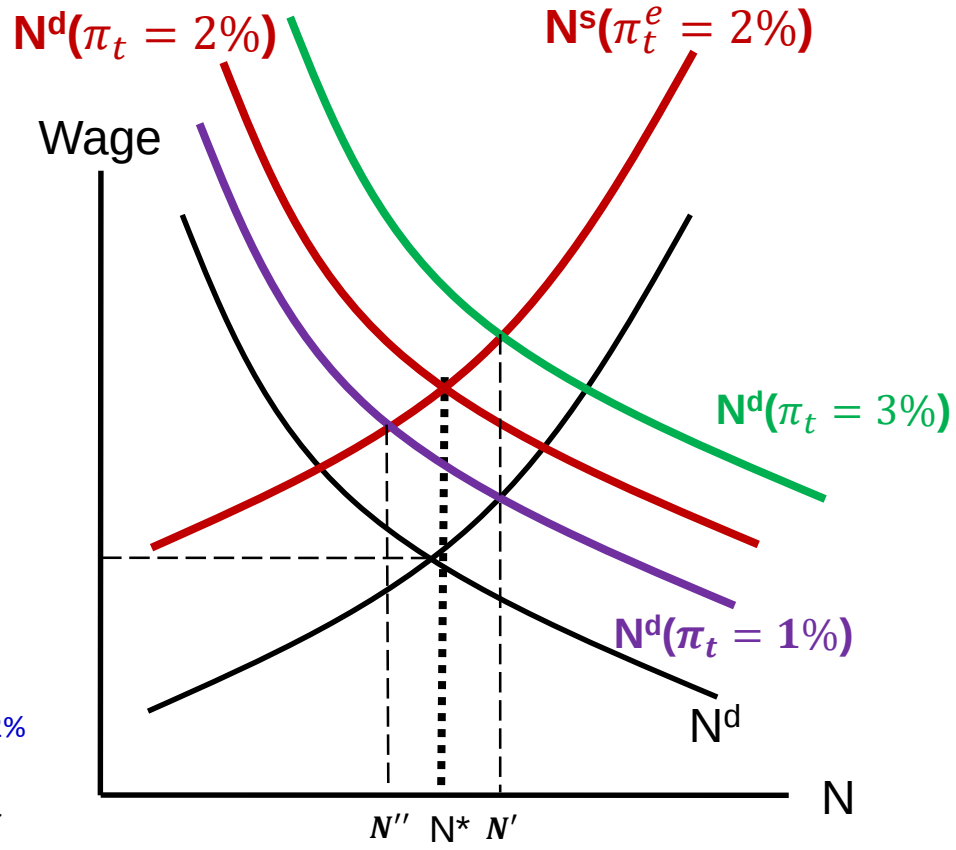
- However, if aggregate demand grows less than expected, causing actual inflation to be 1%, what would happen then?
  - Workers were lead to believe that inflation will be 2%; asking too high nominal wage increase
  - Real wage is higher than expected
  - Underemployment: $\boldsymbol{u_t > u_t^n}$ when $\pi_t < \pi_t^e$



The expectation-augmented Philips curve: Graphing relation

Graphing the Phillips curve (suppose 2% expected inflation)





The expectation-augmented Philips curve: analytical interpretation

What does the relation tell us all about the inflation dynamic?

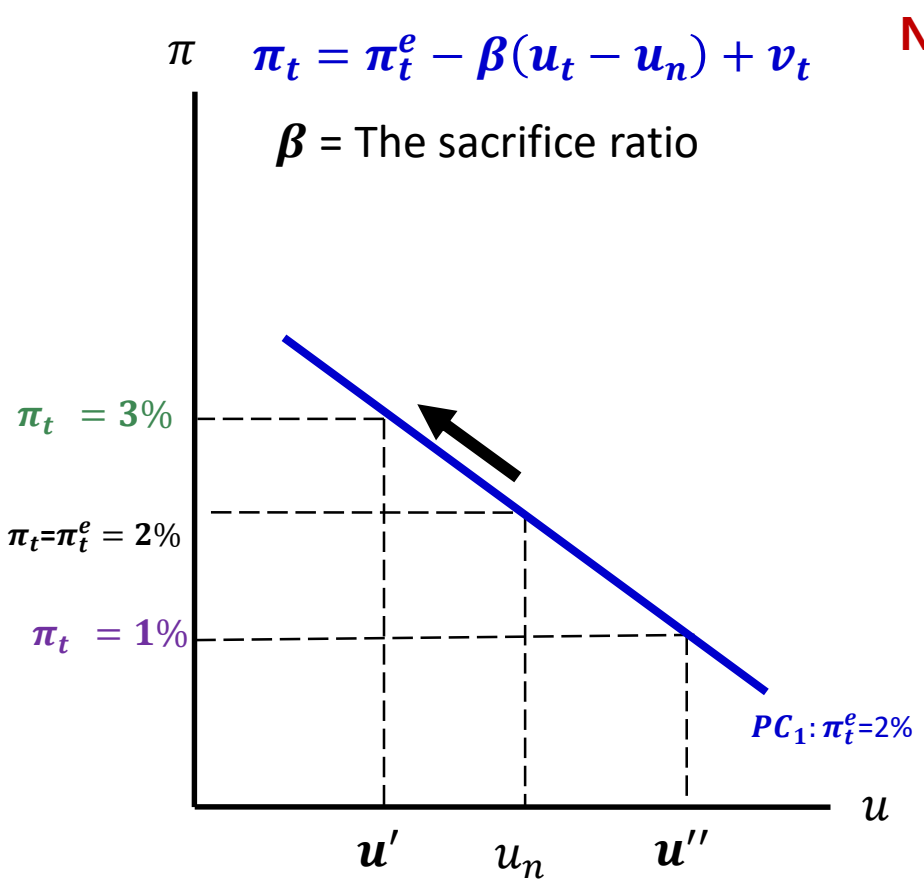
$$\pi_t = \pi_t^e - \beta(u_t - u_n) + v_t$$

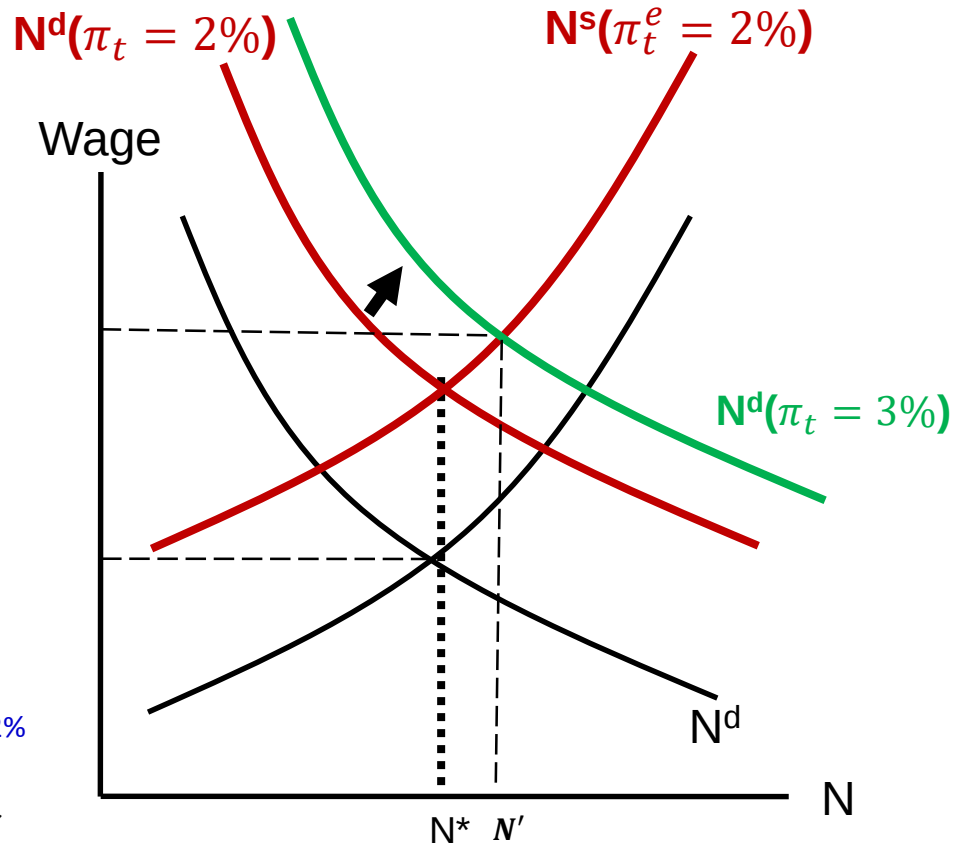
Two (common) causes of rising & falling inflation

- **Demand-pull inflation**: inflation resulting from demand shocks
  - Positive shocks to aggregate demand cause unemployment to fall below its natural rate, which "pulls" the inflation rate up.
- **Cost-push inflation**: inflation resulting from supply shocks
  - Adverse supply shocks typically raise production costs and induce firms to raise prices, "pushing" inflation up.

The expectation-augmented Philips curve: analytical interpretation

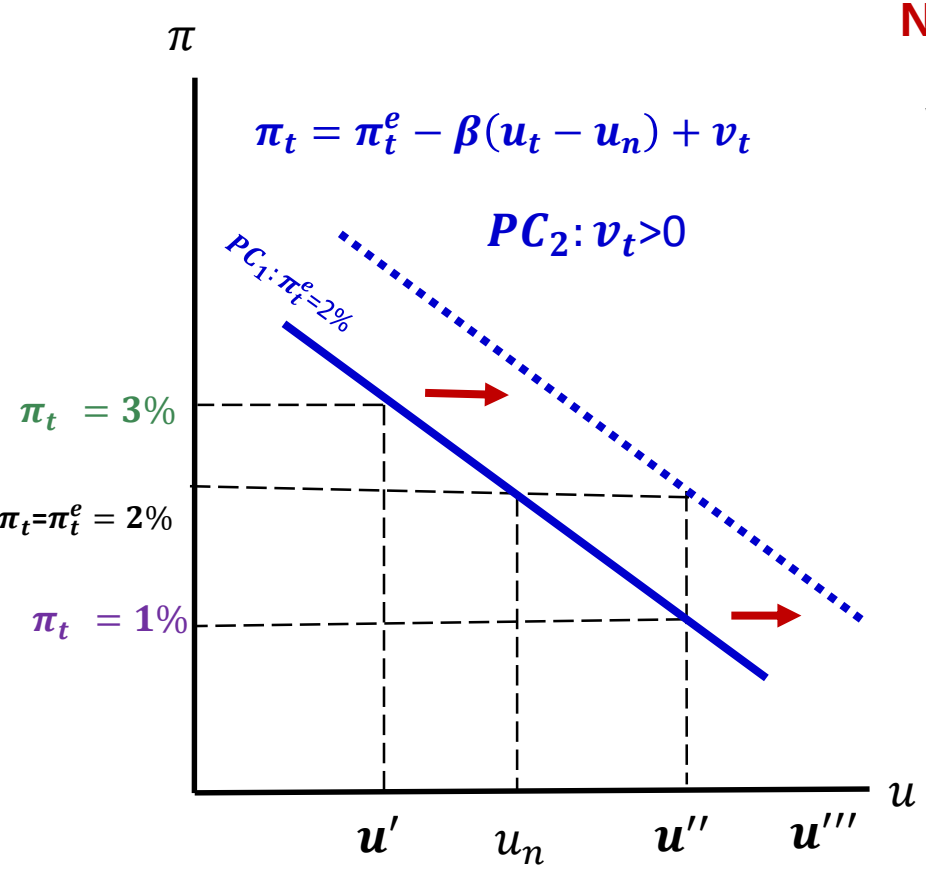
Fixing everything else, rising aggregate demand leads to higher demand for labor, and hence lowering unemployment rate; together this brings about a rise of inflation. → movement along the curve

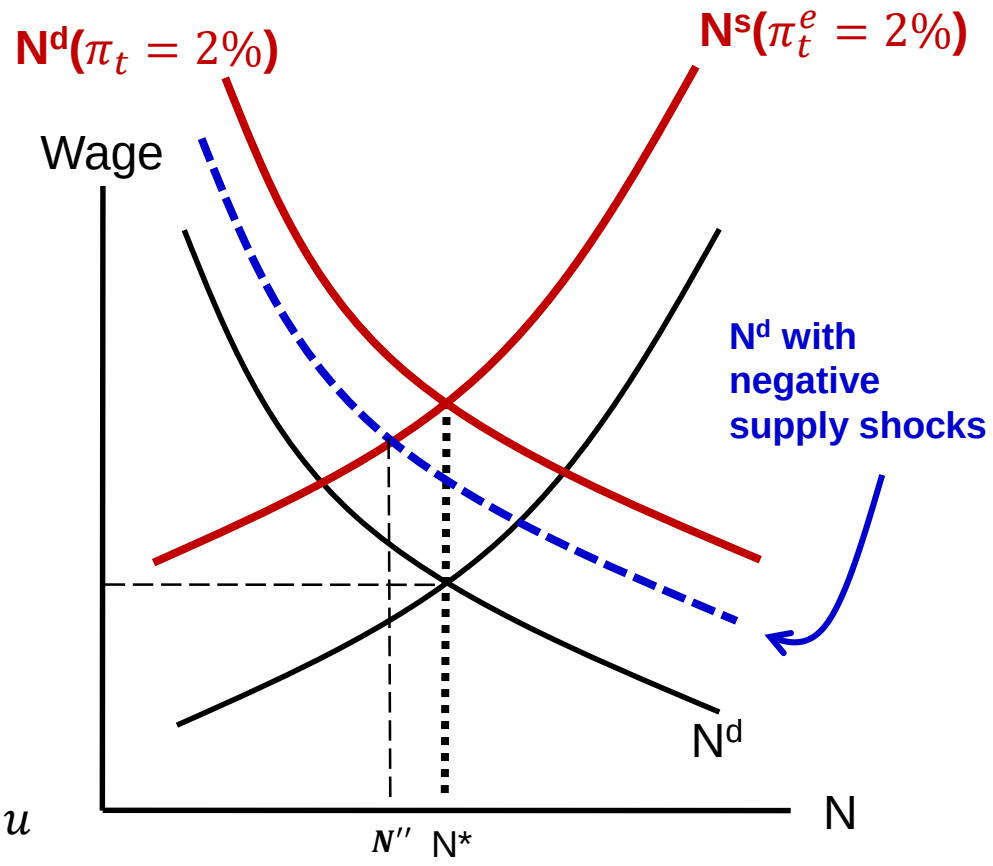




The expectation-augmented Philips curve: analytical interpretation

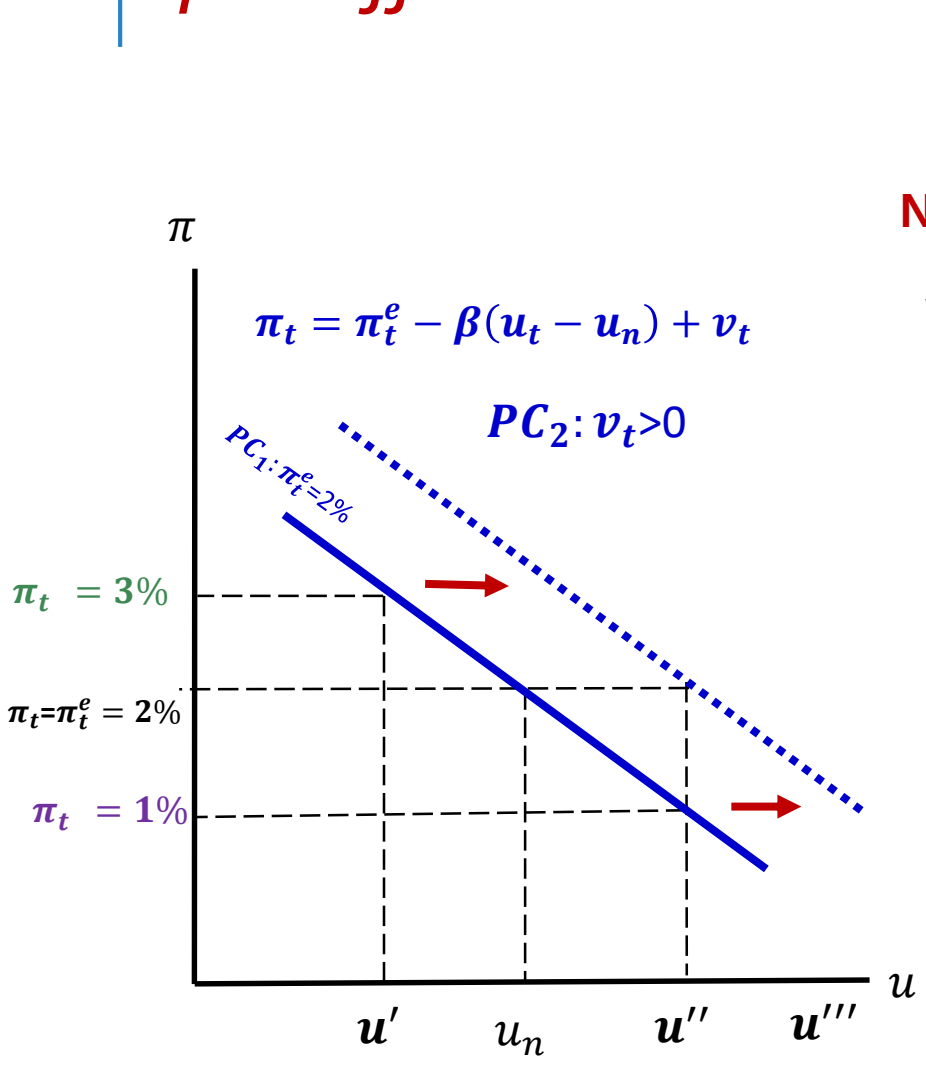
Inflation shocks shift the Phillips curve up: *Cost push effect*

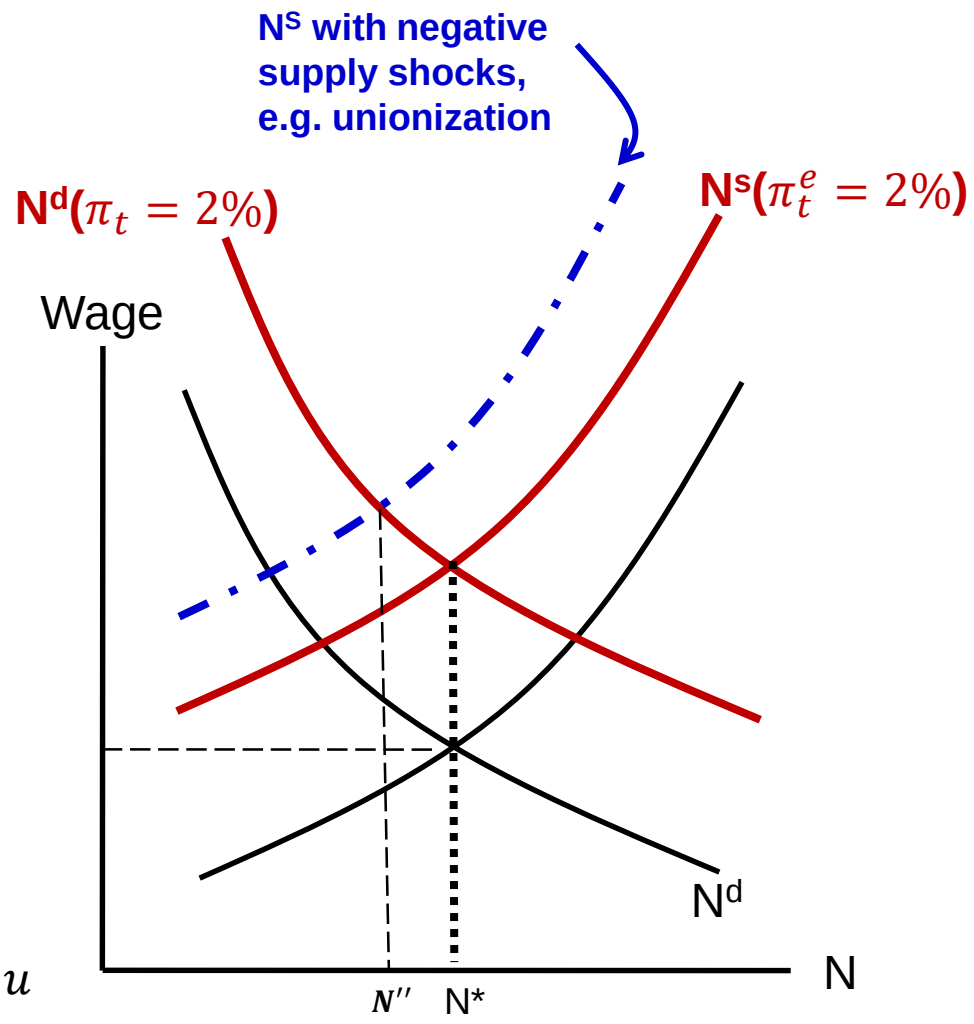




The expectation-augmented Philips curve: analytical interpretation

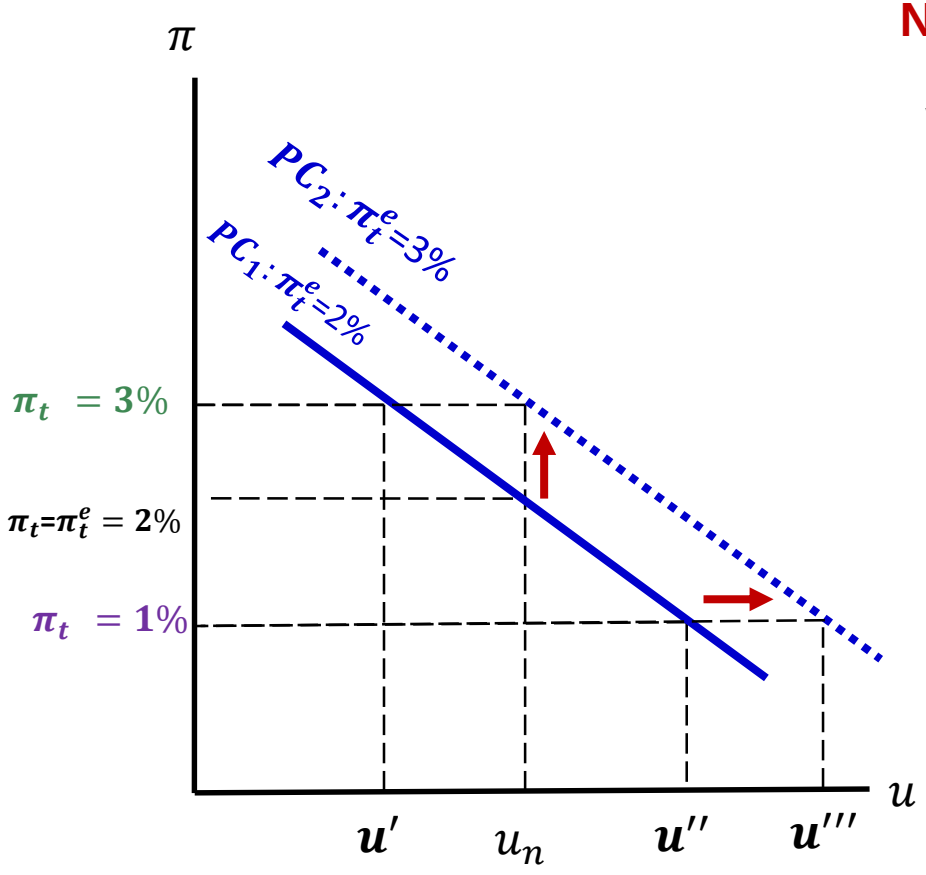
Inflation shocks shift the Phillips curve up: *Cost push effect*

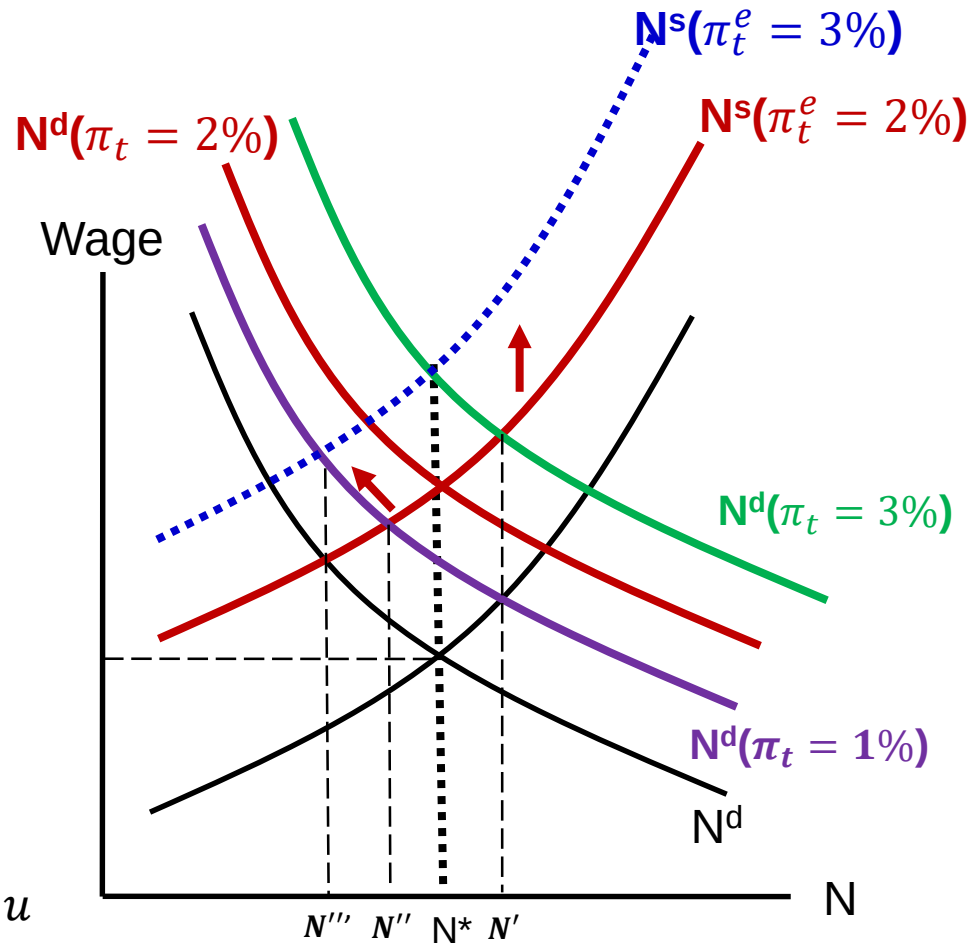




The expectation-augmented Philips curve: analytical interpretation

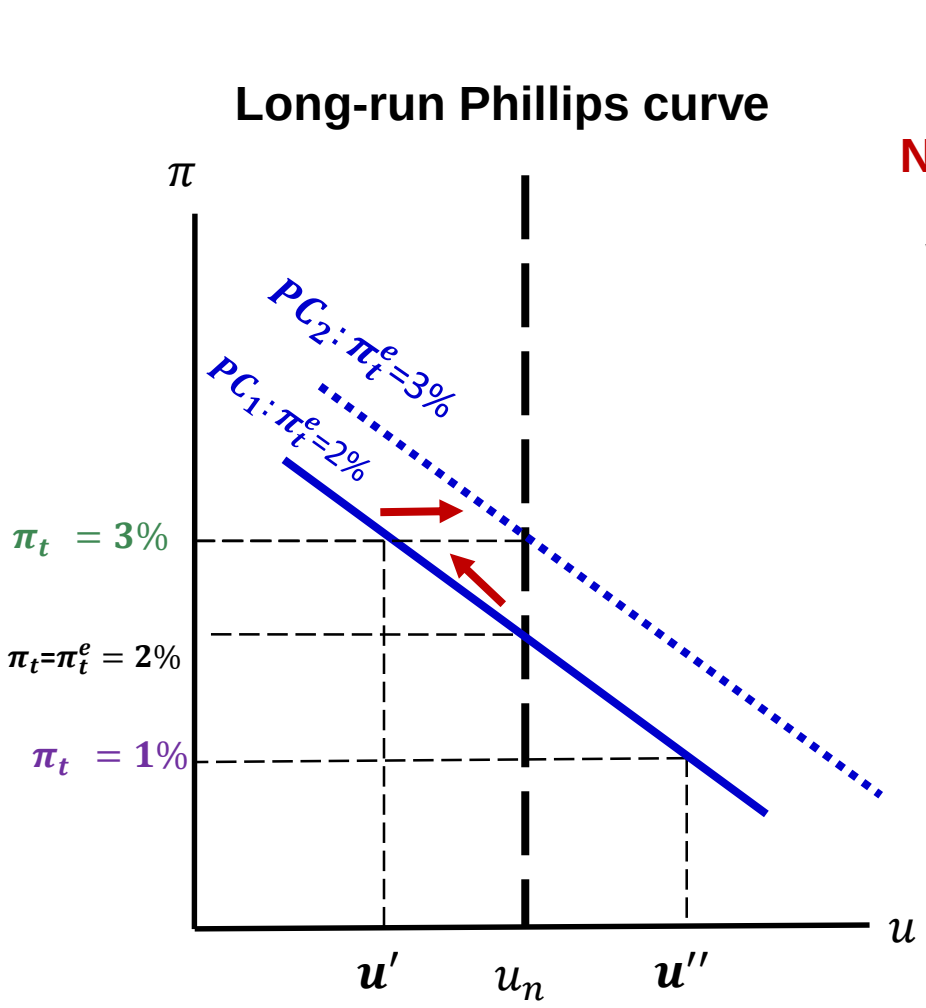
Rising inflation expectation shifts PC curve up: Cost push effect!

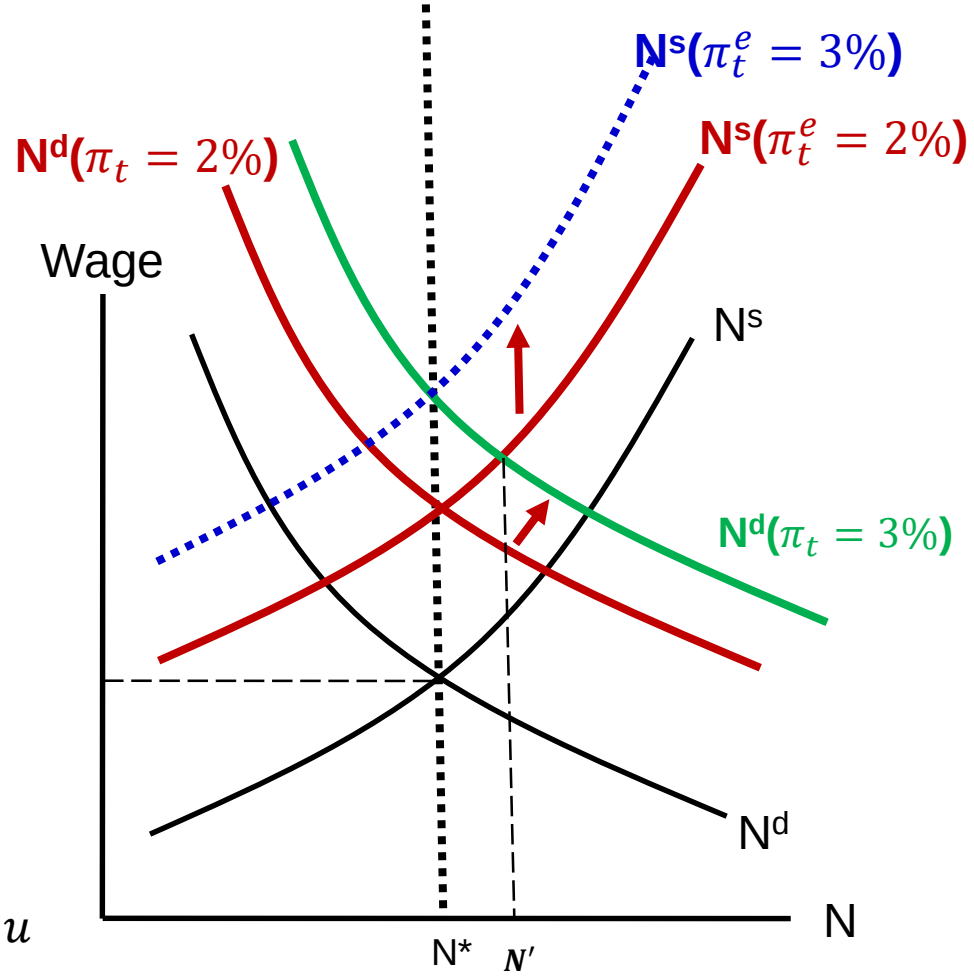




The expectation-augmented Philips curve: analytical interpretation

While there is a trade-off in the short run, the long run Phillips relation does not exhibit a trade-off pattern; LR Phillips curve is vertical.





Case discussion:
How to explain the evolution of inflation dynamic during 60s and 70s

Why did the economists get lured to believe that the relationship between "inflation" and "output" can be captured by the Phillips curve -- permanent trade off?

- The tradeoff works if ***inflation is near zero***.
  - Priori to the oil-shock, inflation was low.
  - **Moreover, people were slow to adjust their inflation expectation**
  - Workers did not bother asking for a higher pay often.
  - This made it look like that the Phillips relation did exist.

The oil shocks simply unveiled the true relationship

- The tradeoff **DOES NOT** work if ***inflation starts to rise***.
  - As the oil shocks happened, people started to realize the impact of inflation.
  - They are quickly to adjust their inflation
  - **Rising inflation expectation persists even if the oil price became stable afterwards**
  - The previously existed trade-off relationship turned out to be no longer true.

How to explain the evolution of inflation dynamic during 60s and 70s

Friedman and Phelps argued for the role of the *adaptive expectation as a behavioral* explanation for *the slowly accelerating inflation observed*.

$$\pi_t^e = \theta \pi_{t-1}$$

$$0 \geq \theta \geq 1$$

$$\pi_t = \theta \pi_{t-1} - \beta(u_t - u_t^n)$$

- **Adaptive expectation:** The agent gradually learns from the past, and predicts current inflation based on *past inflation* -- a behavioral-based expectation

As the inflation had been low before 1960, agents perceived that inflation was not of their concern; θ is near zero

- The UK and US economies before 1960 had very low inflation
  - Agents are sometime inattentive.
  - So, when inflation is closed to zero, they don't bother --- θ is near zero.
  - So the **traditional Phillips curve** was valid, given u_t^n.

$$\pi_t = \pi_t^e - \beta(u_t - u_t^n)$$

$$\pi_t^e = 0$$

$$\pi_t = -\beta(u_t - u_t^n) = \beta u_t^n - \varepsilon u_t$$

- This made the inflation dynamic look very much like a simple downward-sloping relationship between inflation and unemployment rate

How to explain the evolution of inflation dynamic during 60s and 70s

As the policymakers had been lured into the tradeoff fallacy, they pursued pro-growth policy; inflation started to rise while agent began to concern with inflation

- The UK and US economies before 1970 had moderate inflation
  - Agents are still inattentive, but become more concerned.
  - θ is slowly changing from zero to positive.
  - So the **traditional Phillips curve** was valid, given u_t^n.

$$\pi_t^e = \theta \pi_{t-1}$$

$$0 \geq \theta \geq 1$$

$$\pi_t = \theta \pi_{t-1} - \beta(u_t - u_t^n)$$

- θ > o: current inflation depends on past inflation and unemployment.

How to explain the evolution of inflation dynamic during 60s and 70s

1970s was the unfolding story. Inflation quickly accelerated. Oil shocks simply unveiled the problem that had been swept under the rug.

- People change the way they form **inflation expectations**.
  - The value of θ was rising quickly and finally close to 1.
  - This-year inflation is expected to be the same as last-year inflation.
  - The original Phillips curve (and trade-off) broke down.

$$\pi_t = \theta\pi_{t-1} - \beta(u_t - u_t^n)$$

$$\theta = 1$$

$$\pi_t - \pi_{t-1} = -\beta(u_t - u_t^n)$$

- θ = 1, the unemployment rate affects the rate of change in the inflation rate, given the natural rate level.

  As long as $u_t > u_t^n$, decelerating (decreasing) inflation.

  As long as $u_t < u_t^n$, accelerating (increasing) inflation.

Inflation dynamic and policy implications

1. Do not trust any claim without theoretical consideration!

- The original claim on Phillips relation is a good example of the problem generated by the reduced-form approach used in economic study.

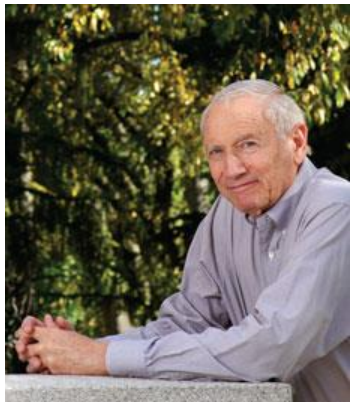
- Data-driven method might work, but can be dangerous!

- Subsequently, most economics framework have emphasized at the **micro-founded approach** since 1970s.

2. Tradeoff may exist, BUT cannot be exploited!


Thomas Sargent


Robert Lucas


Neil Wallace


Robert Barro

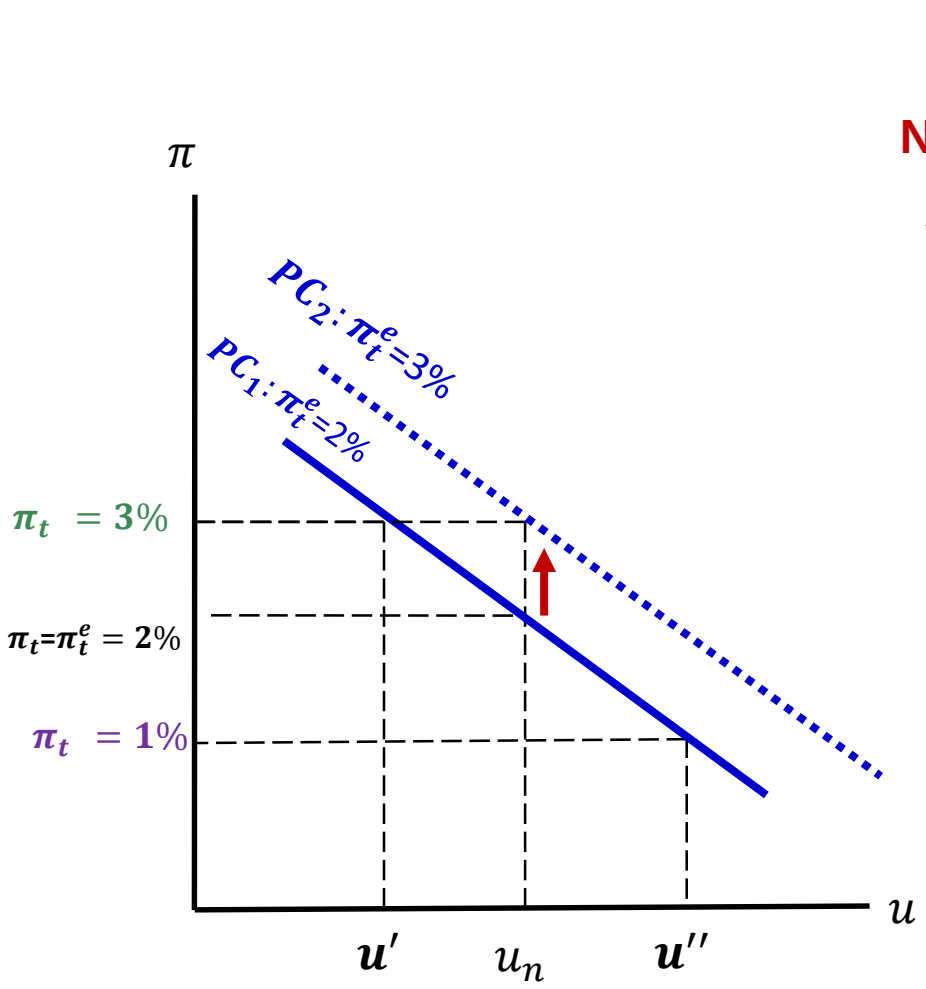
- Friedman (1968) argued for this statement; however, it had received little response
- This was until mid of 1970s when Friedman's concept was further formalized by team of economists – i.e. Sargent, Lucas, Wallace and Barro.
  - Later, they are called a group of "**New Classical economists"**
- They believed and advocated in the concept of ***rational expectation*** *(forward looking expectation)* in economic analysis, and seek for **behavioral implication of rational expectation on policy effects.**

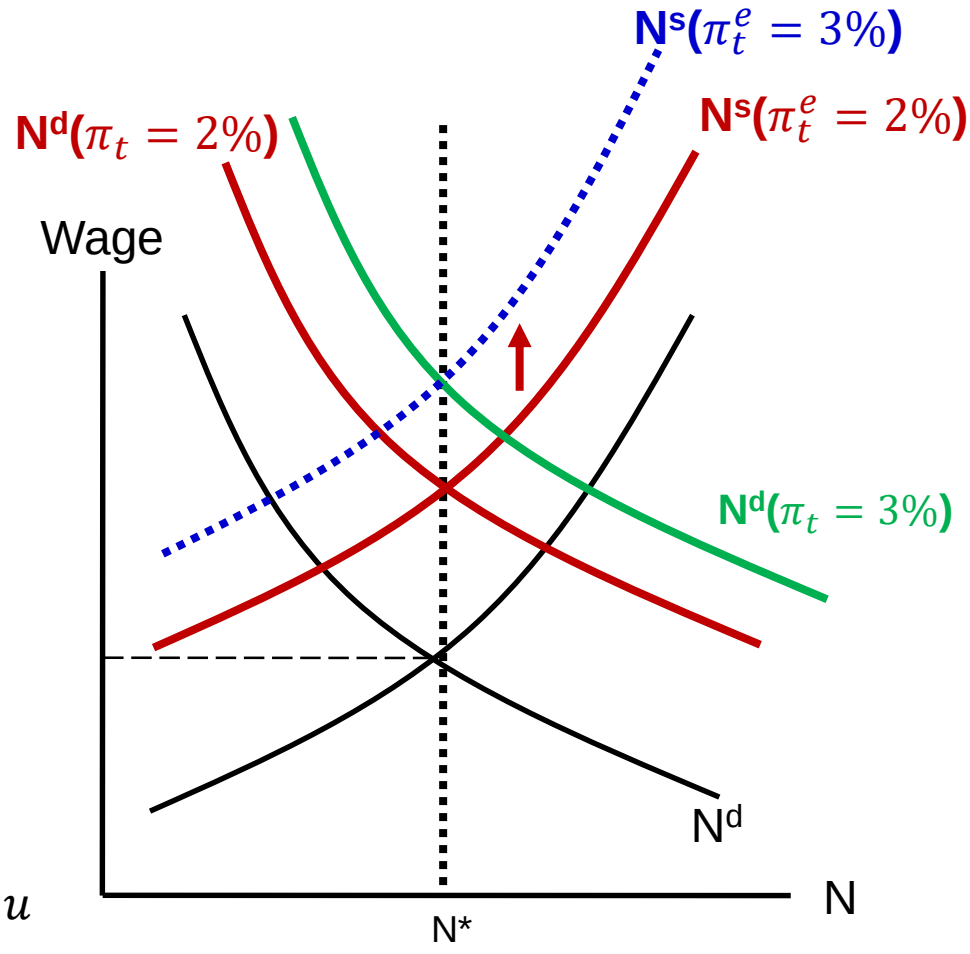
Given the rational expectation, the first implication is that anticipated policy will be neutral!

- An **anticipated** demand management policy will **NOT** matter to the real output!
  - Consider for example an anticipated change in the level of money growth from 2% to 3%
- Given the new high money growth, workers expected the inflation to change from 2% to 3%
- With the rational expectation, they already incorporated this information into the wage-setting
- Once the policy is implemented, it will not generate any real-effect

The rational expectation and New classical economics

> **"Anticipated policy" is neutral; workers fully incorporate the information into their wage setting decision**



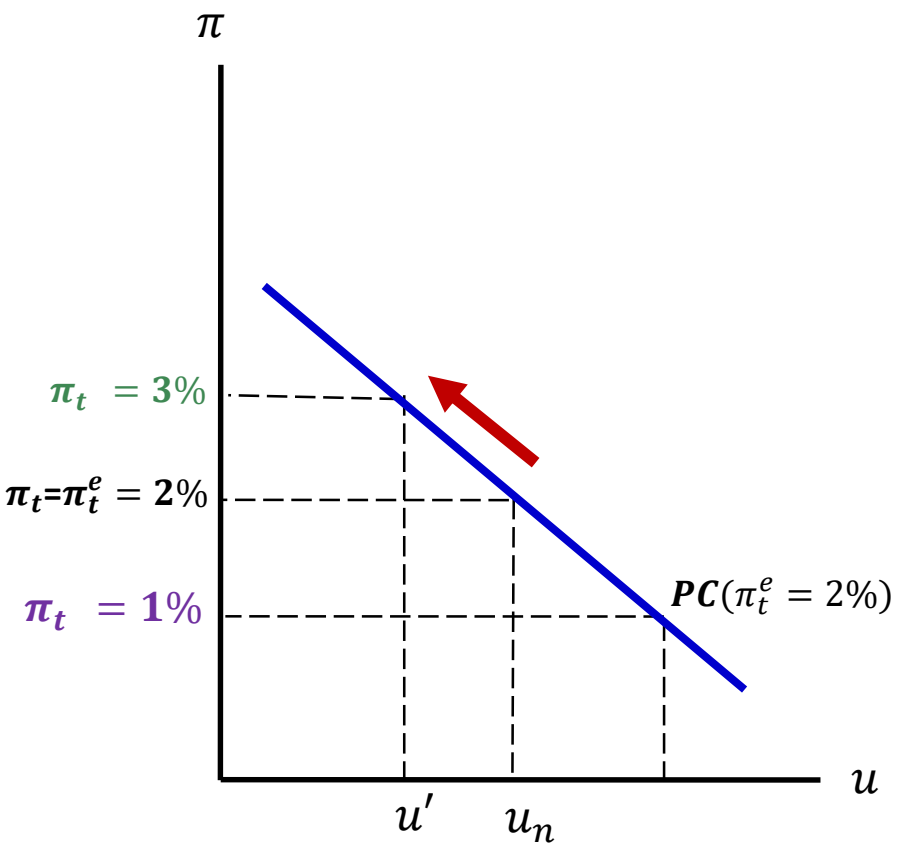


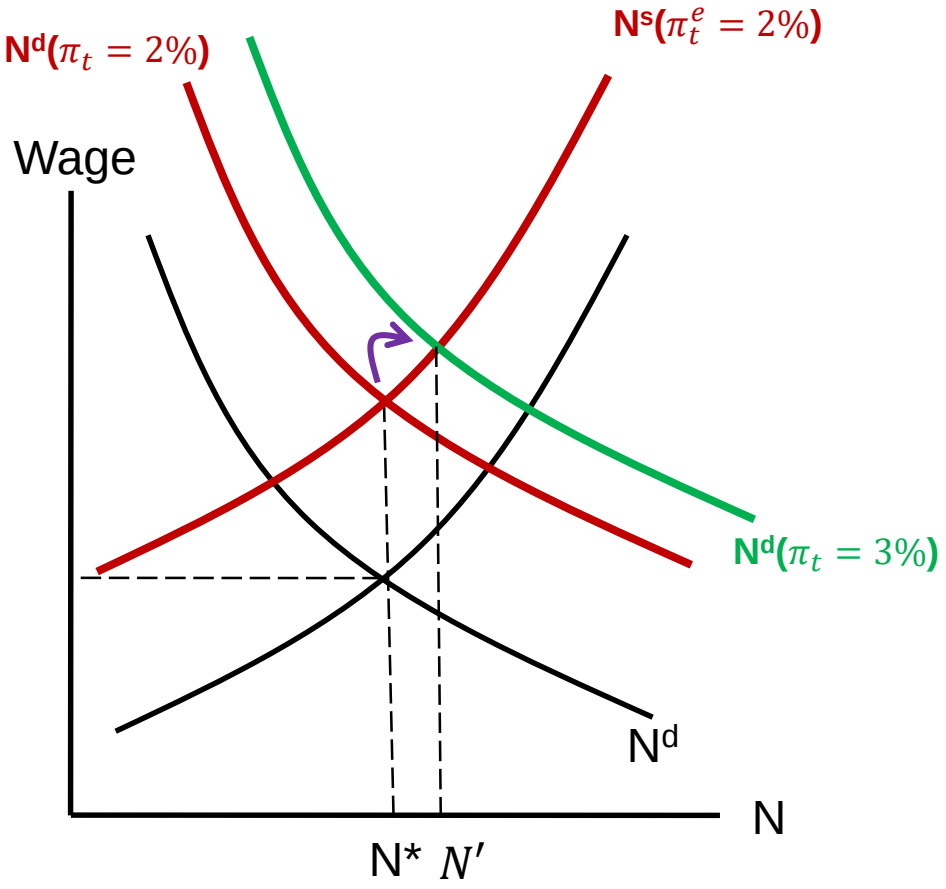
"*Surprised*" policy matters…

- Suppose workers expected a 2% money growth policy, and hence expected 2% inflation.
- Central bank surprisingly increases the money growth to 3%
- Workers then underpredict the inflation, and hence setting their nominal wage for too low.
- Firms benefit from this, can will choose to hire more labor.
- The final outcome is the increase in output in the equilibrium.

The rational expectation and New classical economics

Surprised policy matters; (i) output rises and (ii) unemployment drops below the natural level



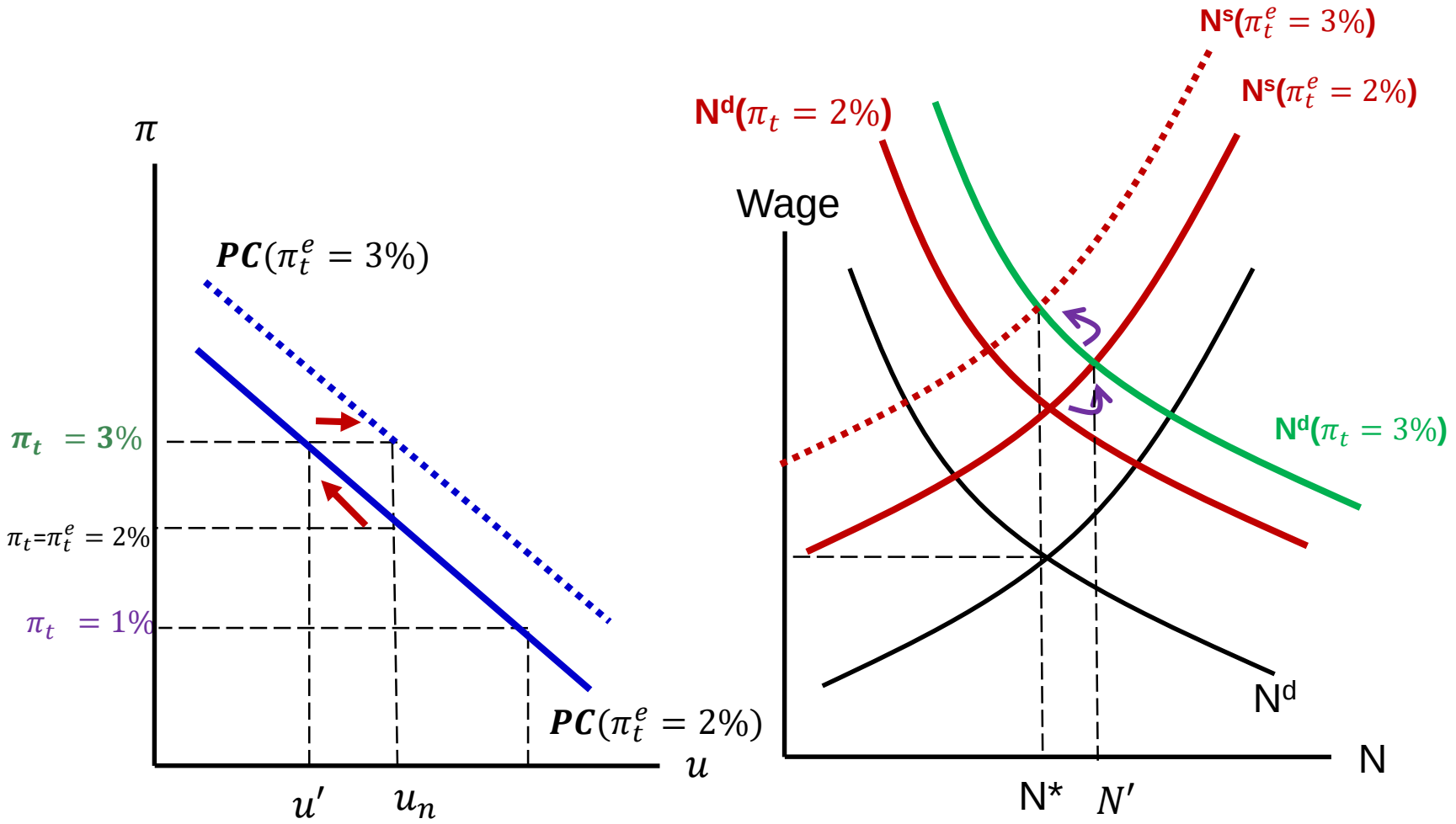


"Surprised" policy matters…BUT does not last long

- Workers will **soon** realize the error; they will **revise** their inflation expectation upward
- Cost of production will rise, and hence discourage firms from choosing to overly produce its output beyond the natural level
- **The self-correction mechanism revisits!**
- **What will be left behind is the higher sustained (or trend) inflation rate.**

The rational expectation and New classical economics

Surprised policy matters…but does not last long



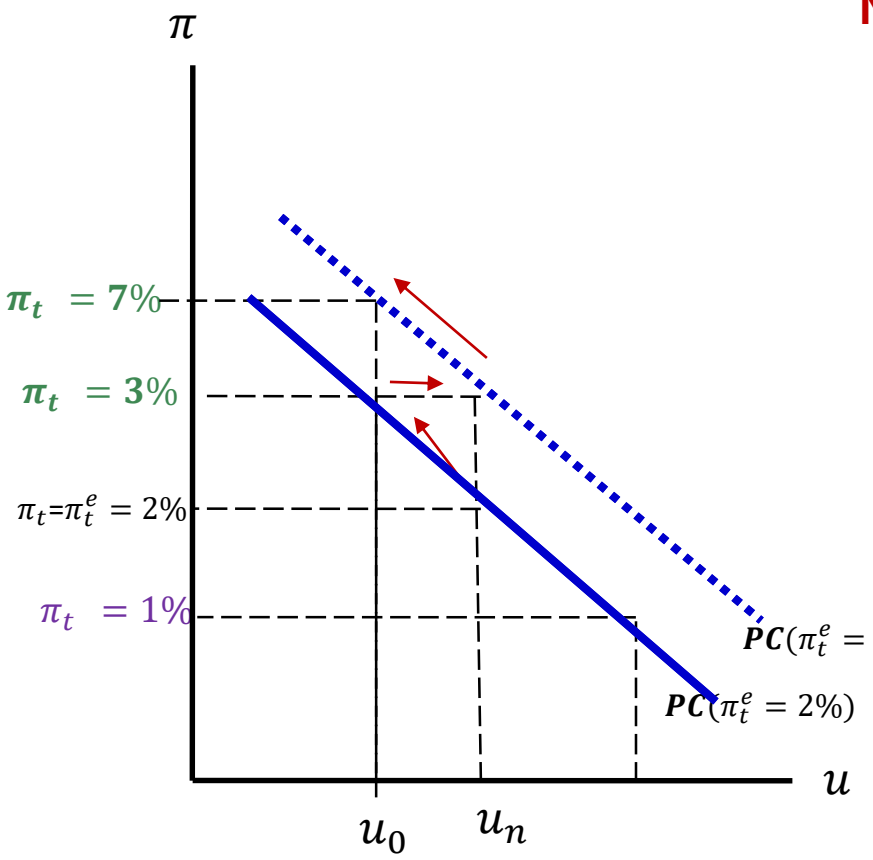
Policy implications

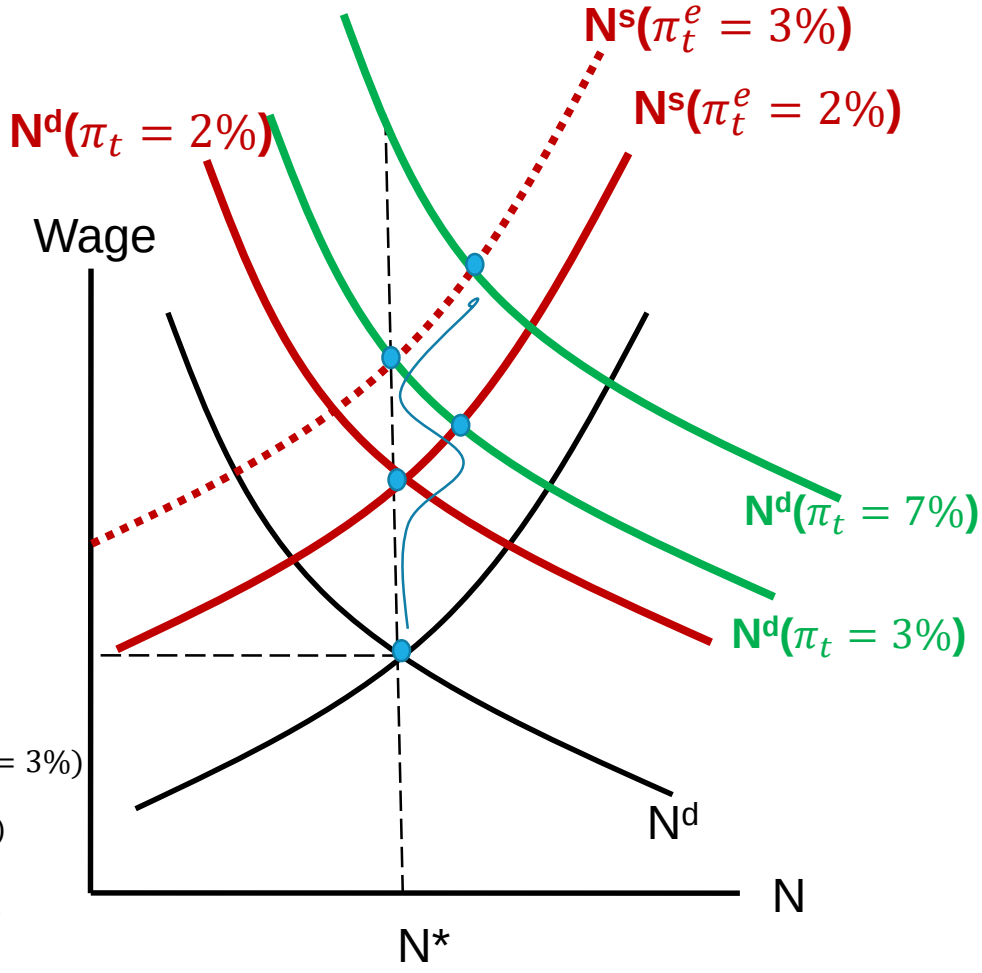
Neither anticipated nor surprised policy are good for the *long-term*; the damage lasts long!

- **Anticipated policy** → inflation pushed up suddenly.

- **Surprised policy** will result in lower unemployment rate (short-term gain) and higher inflation (short-term loss)
  - The tradeoff **should not be exploited! (Phillips curve is vertical in the long-run)**
  - Inflation expectation will play role, and undo the initial real effect.
  - **What only left behind is the *higher sustained (trend) inflation rate.***
  - **At the end, we only have long-term loss, without any gain!**

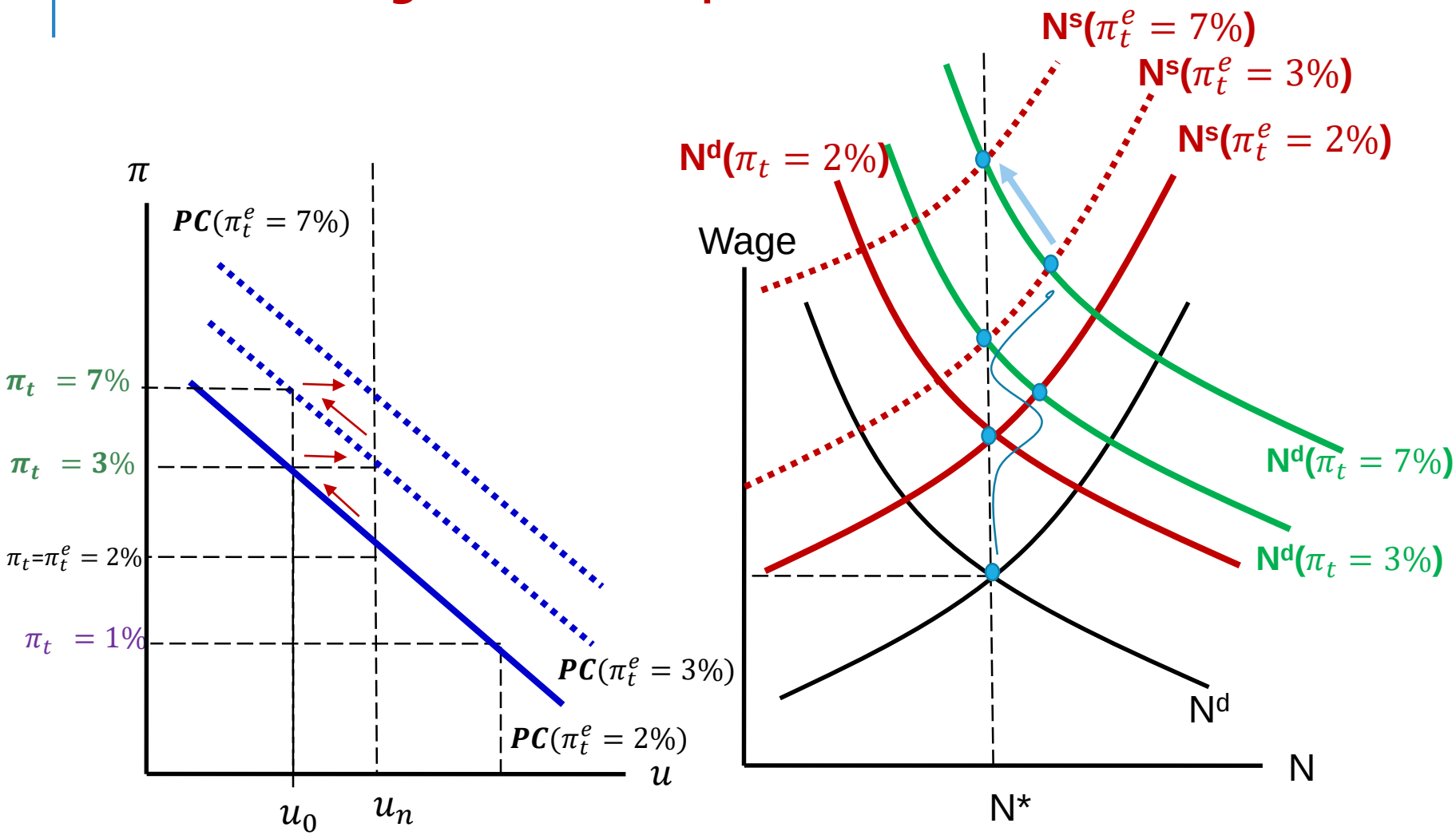
Surprised policy matters…but does not last long





The rational expectation and New classical economics

Opportunistic policy will result in the "accelerating" inflation spiral



Policy implications

Practical policy design should be *less ambitious*, and aim at *achieving price stability*, i.e. having low and stable inflation!

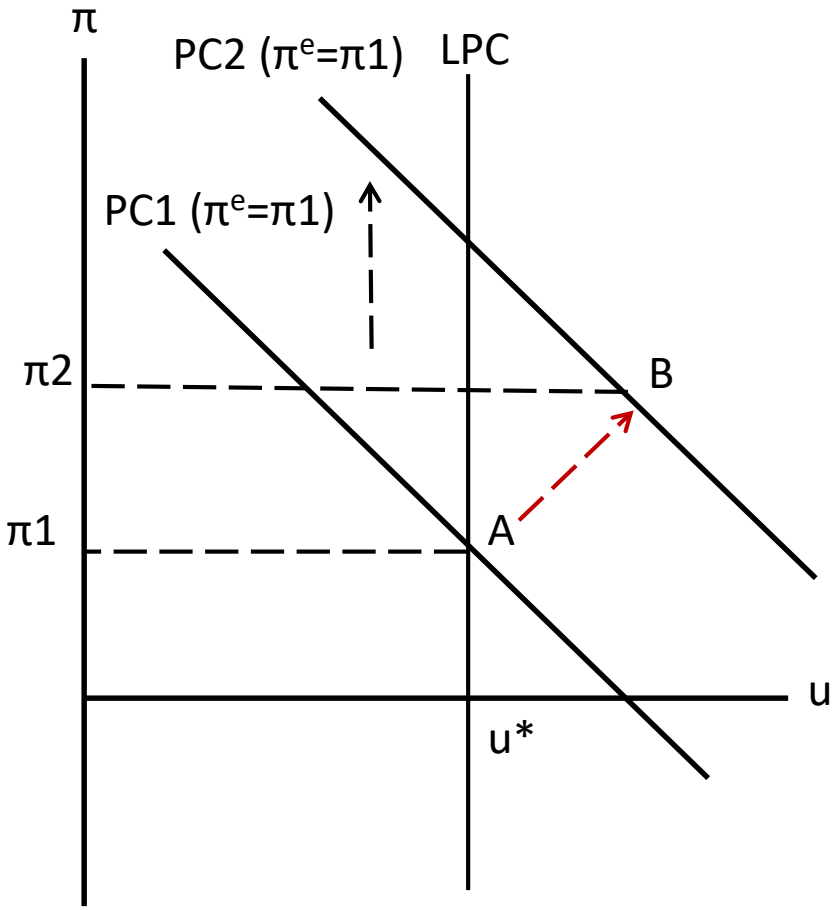
- As we have no real output gain in the long-term, policy should be a rule-based – **avoiding be another source of shock / don't surprise markets!**

- Rule-based central bank should aim at having **low and stable inflation** as its primary objective – inflation targeting!
  - A number of studies have found a huge benefit from anchoring the inflation expectation -- keeping inflation in check or controlled
  - To successfully anchoring inflation, central bank should act tough to build the reputation
  - This will be rewarding as it helps **mitigate the impact of negative supply shock**

Policy implications

Why anchoring low inflation can help mitigating the effect of negative supply shocks?

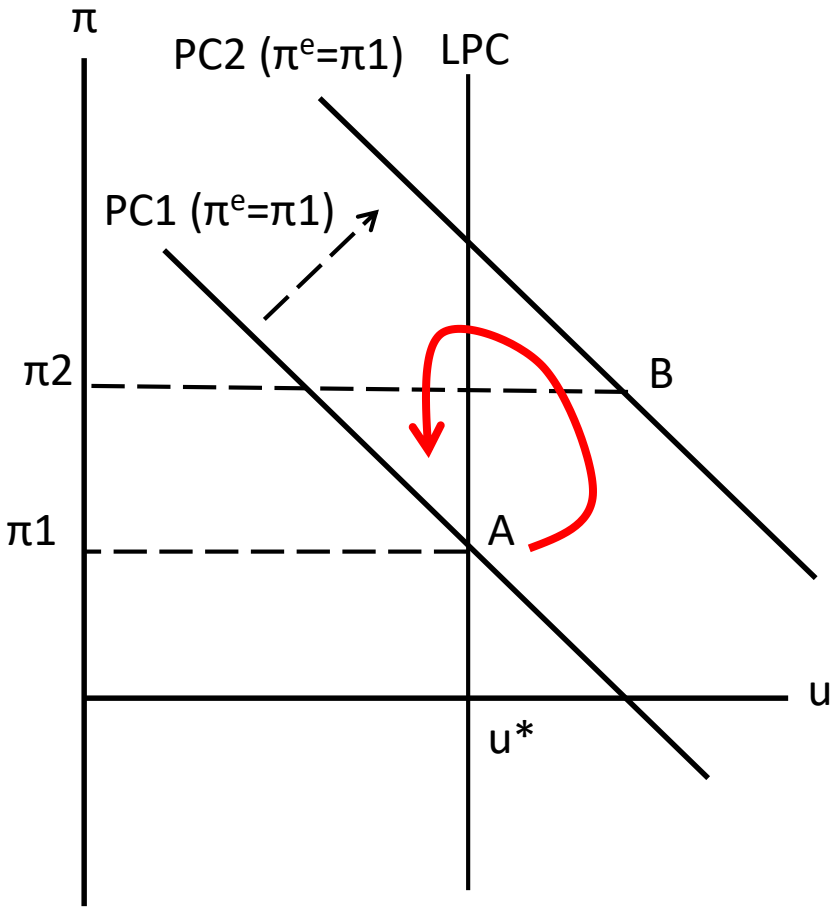
- Negative shocks **temporarily** hit the economy (oil shock)
  - Phillips curve will temporarily shift up to PC2 ($\pi^e=\pi 1$).
- Responding to negative shocks, central bank raises the interest rate to show their commitment in keeping inflation low.
  - Stagflation problem → equilibrium is B.
  - Actual inflation rises, but not rapidly.
- Good thing: Inflation expectation remains anchored at π1 even the actual inflation is π2.



Policy implications

Why anchoring low inflation can help mitigating the effect of negative supply shocks?

- Consider next period when shocks have been gone; everything is back to PC1 ($\pi^e=\pi1$)
  - This is because the inflation expectation remains anchored at π1, not being revised to π2.
  - Return to natural equilibrium with the same level of inflation as before → A
- Benefit from anchoring the low inflation expectation makes the transition path less painful.
  - Benefit from a temporary stagflation



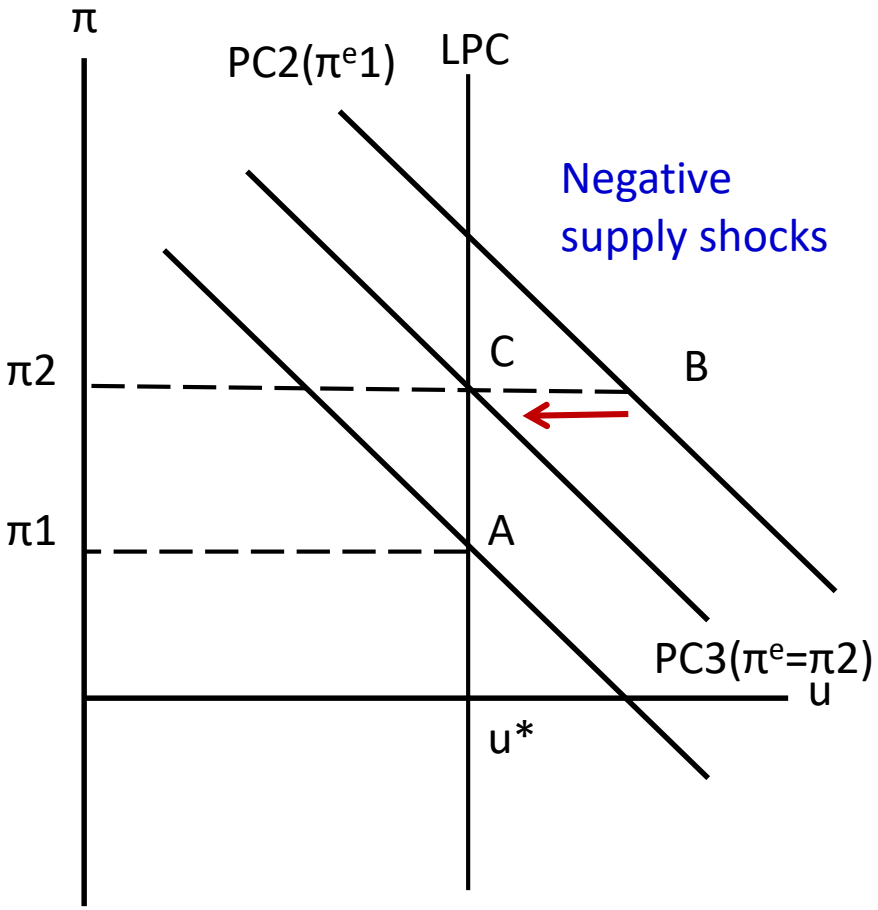
Policy implications

Why anchoring low inflation can help mitigating the effect of negative supply shocks?

- Instead, if the central bank does not commit to a low inflation, **the effect of negative shocks will last, and cause high inflation economy.**

- Even if the period of shocks have passed by, economy would still remain at "C" when we have high inflation ($\pi^e=\pi 2$).

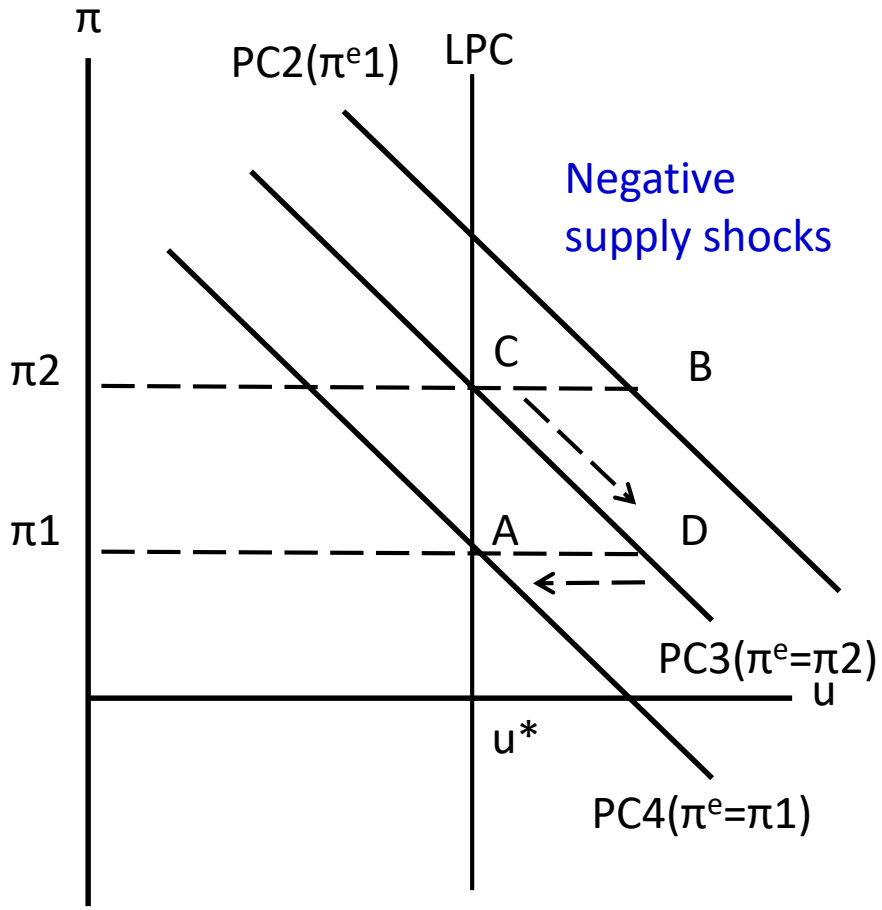
- The attempt to bring down inflation would require another stagflation, i.e. require a strong medicine.



Policy implications

Why anchoring low inflation can help mitigating the effect of negative supply shocks?

- To fight the inflation, central bank must aggressively raise interest rate and show their intention to create the disinflation come down; equilibrium stagflation occurs at D
- Once public starts to believe this, inflation expectation will gradually come down, given by $PC_4(\pi^e=\pi 1)$
- **However, it is more painful transition.**



Appendix: benefit and cost of inflation

DISCUSSION QUESTION

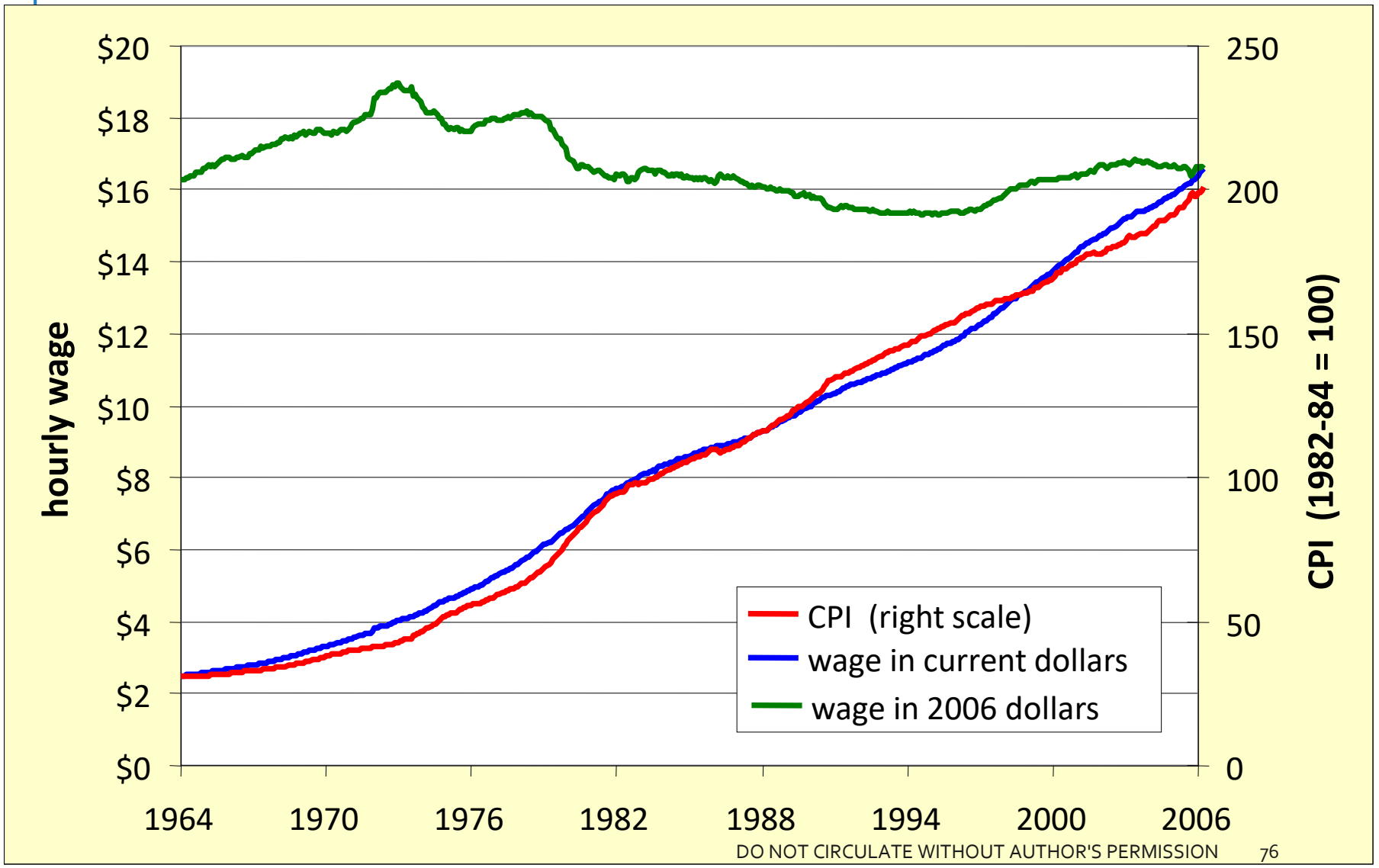
Why is inflation bad?

- What costs does inflation impose on society? List all the ones you can think of.
- Focus on the long run.
- Think like an economist.

A COMMON MISPERCEPTION

- Common misperception:
  inflation reduces real wages
- This is true only in the short run, when nominal wages are fixed by contracts.
- (Chap. 3) In the long run, the real wage is determined by labor supply and the marginal product of labor, not the price level or inflation rate.
- Consider the data…

AVERAGE HOURLY EARNINGS AND THE CPI, 1964-2006



THE CLASSICAL VIEW OF INFLATION

- *The classical view:*
  A change in the price level is merely a change in the units of measurement.

So why, then, is inflation a social problem?

THE SOCIAL COSTS OF INFLATION

…fall into two categories:

1. costs when inflation is expected
2. costs when inflation is different than people had expected

THE COSTS OF EXPECTED INFLATION: 1. SHOELEATHER COST

- def: the costs and inconveniences of reducing money balances to avoid the inflation tax.
- $\uparrow \pi \Rightarrow \uparrow i$

  $\Rightarrow \downarrow$ real money balances
- Remember: In long run, inflation does not affect real income or real spending.
- So, same monthly spending but lower average money holdings means more frequent trips to the bank to withdraw smaller amounts of cash.

THE COSTS OF EXPECTED INFLATION: 2. MENU COSTS

- def: The costs of changing prices.
- Examples:
  - cost of printing new menus
  - cost of printing & mailing new catalogs
- The higher is inflation, the more frequently firms must change their prices and incur these costs.

THE COSTS OF EXPECTED INFLATION: 3. RELATIVE PRICE DISTORTIONS

- Firms facing menu costs change prices infrequently.
- Example:
  A firm issues new catalog each January.
  As the general price level rises throughout the year, the firm's relative price will fall.
- Different firms change their prices at different times, leading to relative price distortions…

  …causing microeconomic inefficiencies in the allocation of resources.

THE COSTS OF EXPECTED INFLATION: 4. UNFAIR TAX TREATMENT

Some taxes are not adjusted to account for inflation, such as the capital gains tax.

Example:

- Jan 1: you buy $10,000 worth of IBM stock
- Dec 31: you sell the stock for $11,000, so your nominal capital gain is $1000 (10%).
- Suppose $\pi = 10\%$ during the year. Your real capital gain is $0.
- But the govt requires you to pay taxes on your $1000 nominal gain!!

THE COSTS OF EXPECTED INFLATION: 5. GENERAL INCONVENIENCE

- Inflation makes it harder to compare nominal values from different time periods.
- This complicates long-range financial planning.

ADDITIONAL COST OF *UNEXPECTED* INFLATION: ARBITRARY REDISTRIBUTION OF PURCHASING POWER

- Many long-term contracts not indexed, but based on π^e.
- If π turns out different from π^e, then some gain at others' expense.

  Example: borrowers & lenders

  - If $\pi > \pi^e$, then $(i - \pi) < (i - \pi^e)$ and purchasing power is transferred from lenders to borrowers.
  - If $\pi < \pi^e$, then purchasing power is transferred from borrowers to lenders.

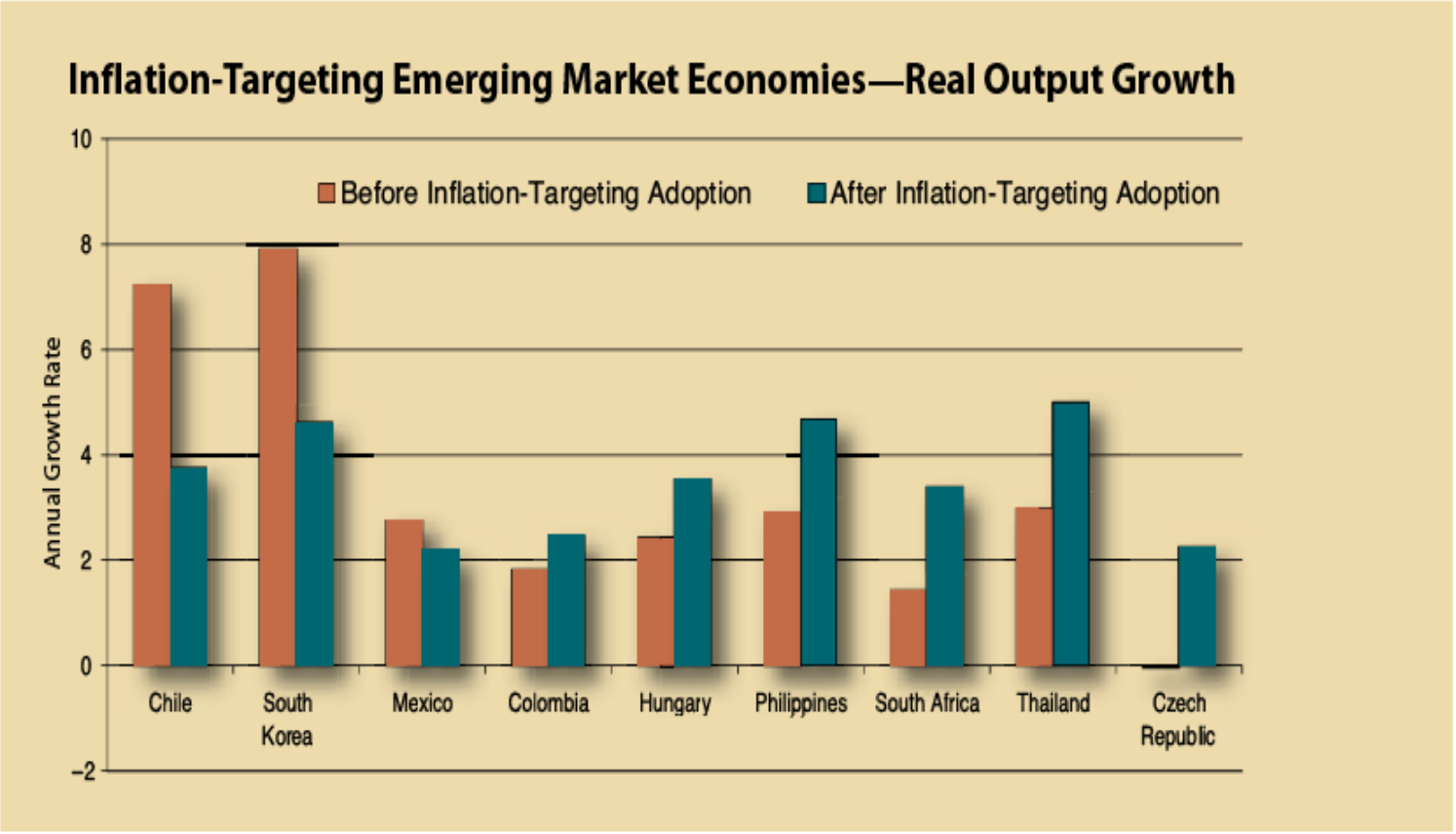
ADDITIONAL COST OF HIGH INFLATION: INCREASED UNCERTAINTY

- When inflation is high, it's more variable and unpredictable:
  π turns out different from π^e more often, and the differences tend to be larger
  (though not systematically positive or negative)
- Arbitrary redistributions of wealth become more likely.
- This creates higher uncertainty, making risk averse people worse off.

ONE BENEFIT OF INFLATION

- Nominal wages are rarely reduced, even when the equilibrium real wage falls.
  This hinders labor market clearing.
- Inflation allows the real wages to reach equilibrium levels without nominal wage cuts.
- Therefore, moderate inflation improves the functioning of labor markets.

DOES "INFLATION TARGETING" INCREASE REAL OUTPUT GROWTH?



HOW DID NON-INFLATION-TARGETERS PERFOM? (ANDERSON)