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# Aggregate Demand & Aggregate Supply

Adding Swings in the Overall Price Level  
to our Model of the Economy

# Outline

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1. Aggregate Demand
  2. Aggregate Supply
  3. Macroeconomic Equilibrium
- Textbook Readings: Ch. 13

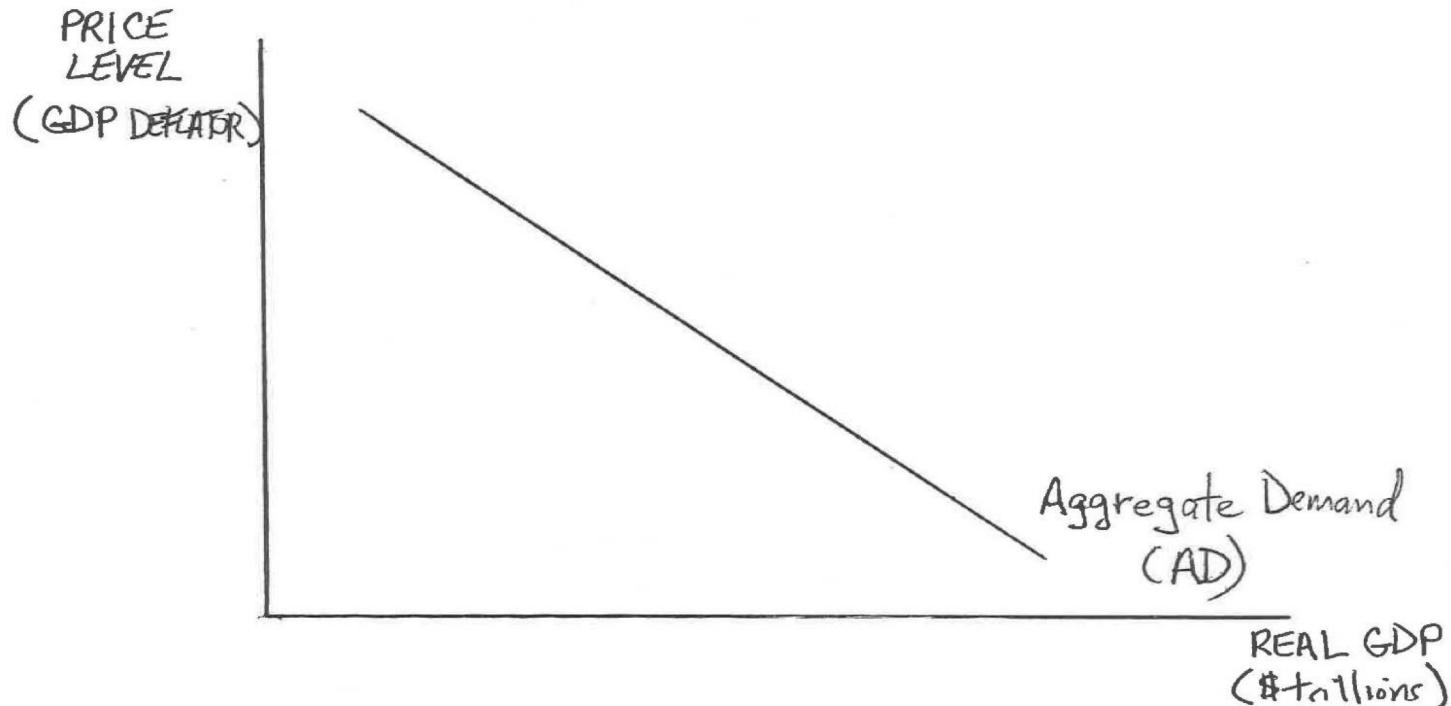
# AD-AS Model

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- New model: Links **output changes** to **changes in the price level**
  - AE model looks only at output swings
- How do changes in **demand** affect aggregate output **and the price level?**
- How do changes in **supply** affect aggregate output **and the price level?**
- How do changes in **price level** affect aggregate output level?

# The Aggregate Demand Curve

- A downward sloping AD curve
  - As the overall price level falls, the level of output rises



# Why the AD Curve is Downward Sloping?

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- Microeconomic theory:
  - Law of demand: When the price of an individual good falls, demand rises
  - **Assuming all other prices are stable!**
  - Why demand curves slope downward?
  - When the price of the good falls, people are willing to buy more, why?
    - ❖ **Substitution effect** – Good is cheaper relative to other goods
    - ❖ Income effect – Increase in purchasing power
- The AD curve is DIFFERENT!
  - Aggregate Demand is a **macroeconomic concept**

# Why the AD Curve is Downward Sloping?

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- Macroeconomic Theory:
  - Substitution effects **do not** explain the AD curve
- Aggregate Demand curve depicts the effects on **overall demand**, given a change in the prices of **all goods and services**
- Clearly, substitution of one good for another cannot explain a shift in **overall demand** given a shift in **overall prices**

# Why Fall In Price Level Associated With Higher Output?

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- **Wealth Effect:**

- Some HH wealth is held in nominal assets
- As price level rises, real value of HH wealth declines → **Less consumption**

- **Interest Rate Effect:**

- When prices rise, HH and firms need more money to finance buying and selling (increase in demand for money)
- “Price” of holding money (interest rate) rises, **discouraging investments**

- **International-Trade Effect:**

- As price level rises, **NX fall**

# The Wealth Effect Explained

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- Ernie has **\$20,000** in the bank
- A moped cost **\$8,900**. A 12' flat screen TV costs **\$9,200**. A vacation to Paris for a month costs **\$9,700**. He plans to buy **two** of these three items, after graduation
- By then, prices leap (inflation is 20%)
- New prices: Moped = **\$10,680** TV = **\$11,040** Vacation = **\$11,640**
- Ernie now buys only **one** of the items

# The Interest Rate Effect Explained

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- HH keep financial wealth in various places: cash, bonds, stocks
- HH **hold enough cash** to make it easy to pay their bills
- **If prices jump**, HH must sell some bonds and stocks to **increase** their **cash holdings**
- Sell bonds → Prices fall → Interest rates rise → Less investment

# The Interest Rate Effect Explained: Example

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- Bert, Ernie, Big Bird, Miss Piggy and the Count all keep, on average, **\$5,000** in their checking account to pay bills
- **Prices fall** (inflation is -1%)
- They all decide they only need **\$3,000** in their accounts now to pay bills
- They all buy bonds → Supply of funds rise → **Interest rates fall**
- Lower real rates **boost** home building (**investment spending**)

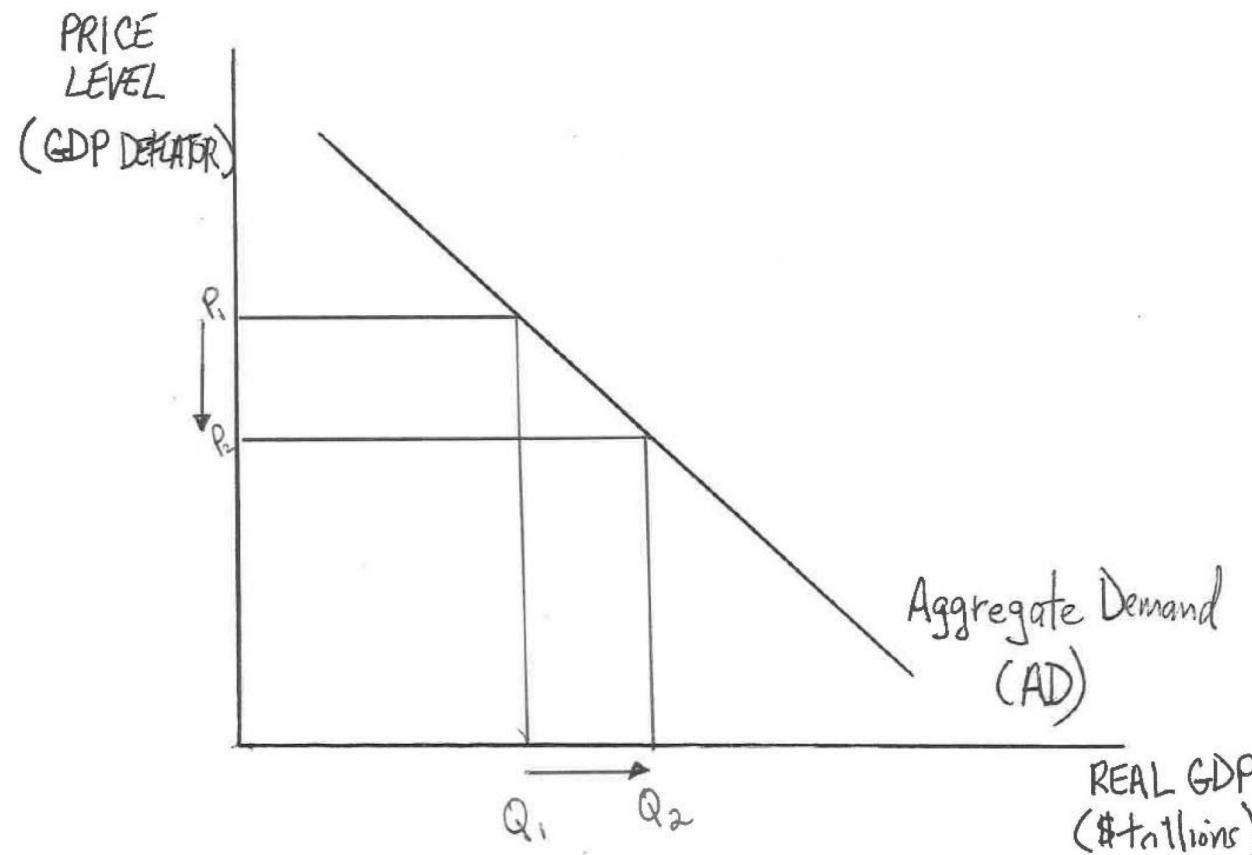
# The International-Trade Effect Explained

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- As **prices go up**, foreigners can afford less domestic goods → Exports go down
- Likewise, it is easier to import → Imports go up
- **Net exports go down unambiguously**

# A Movement Along the AD Curve

- As the price level falls, output rises

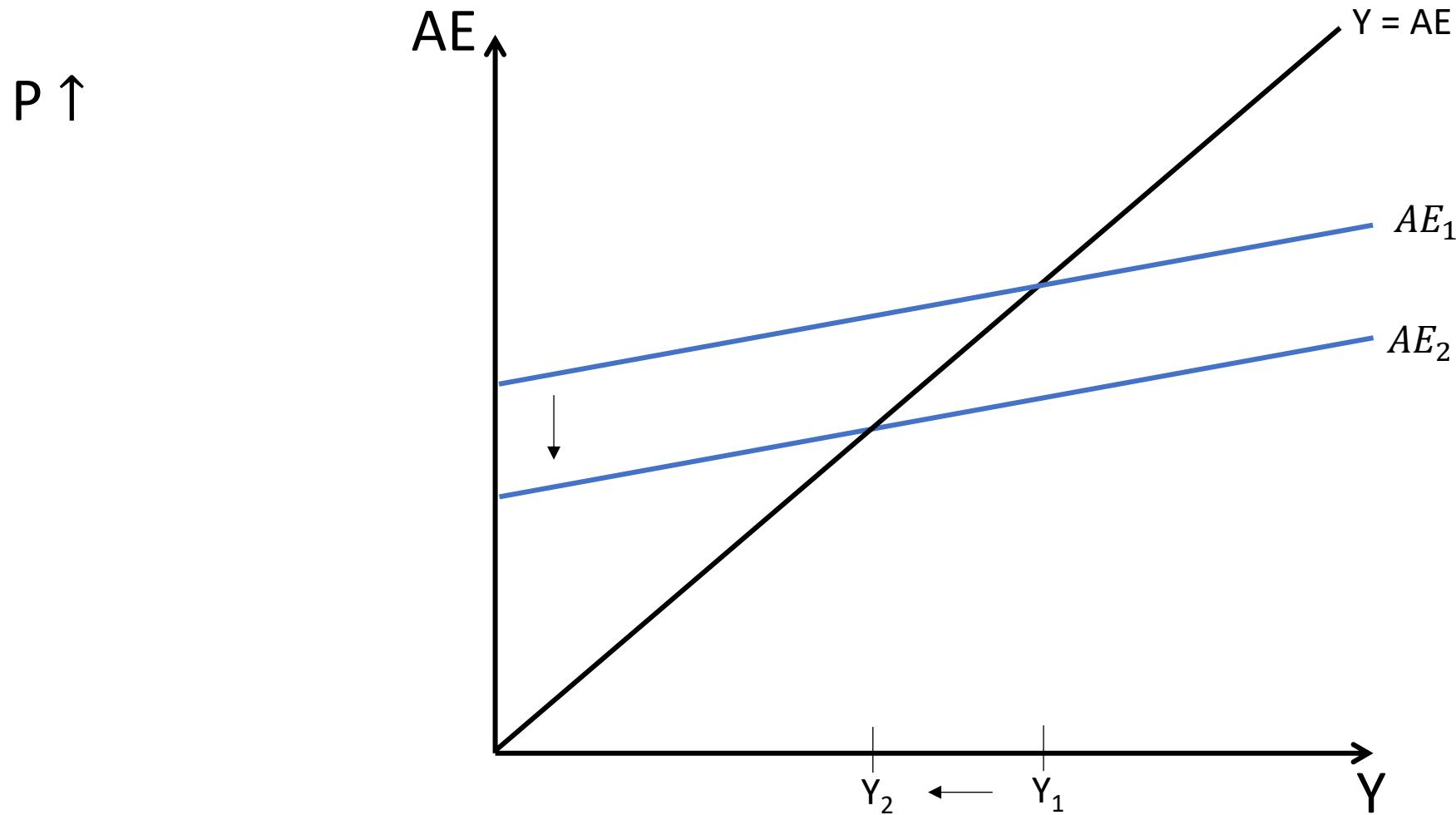


# From AE Model to AD-AS Model: A Simple Derivation

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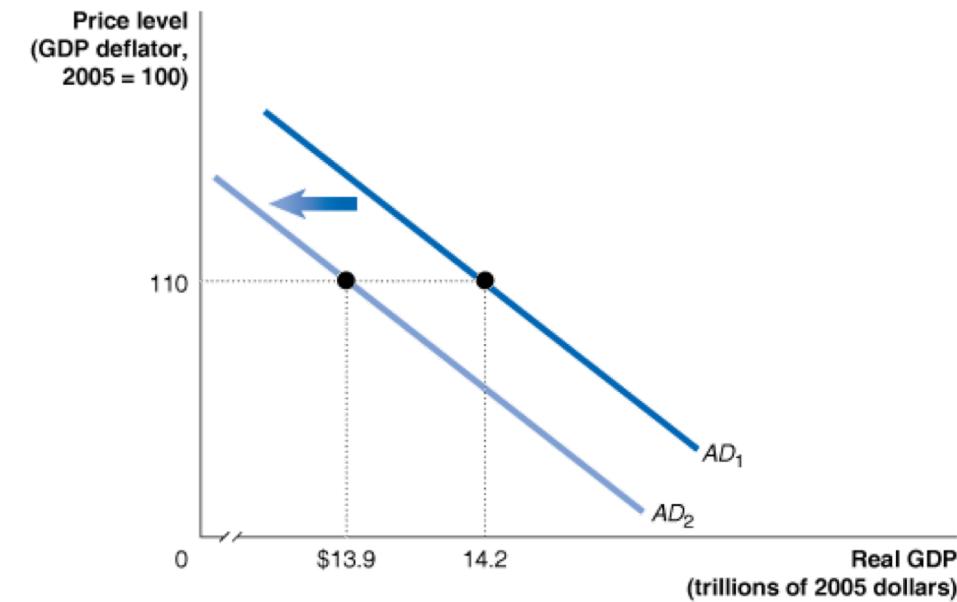
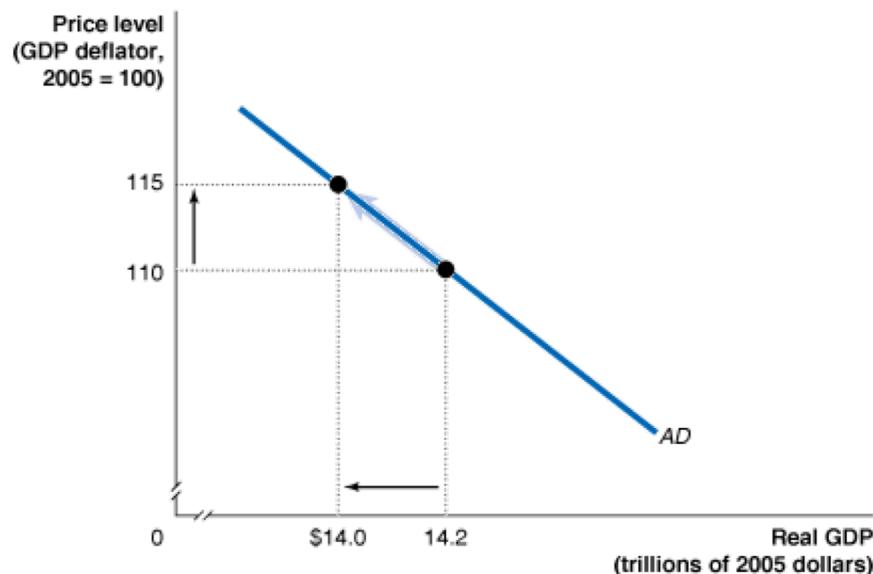
- Our AE model assumes that the overall price level is fixed
  - Reflects our assumption that there is enough capacity to increase output
- Here we relax that assumption
- Prices jump from period 1 to period 2, what happens to AE?
  - AE line falls at any level of output
  - Equilibrium is now lower
- Thus, we can ‘derive’ the AD line by manipulating our AE model

# AE Model: ‘Embedded’ in the AD-AS Model



# Shifts vs Movements Along the AD Curve

- AD curve shows the relationship between the price level and real GDP *demanded, holding everything else constant*
- A change in a variable **other than the price level** will shift AD curve



# Shifts in the AD Curve

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- Demand shock: Unexpected event that causes AD curve to shift
- AD shifts when:
  - Government policies change
  - Expectations of HH and firms about the future change
  - Foreign variables change

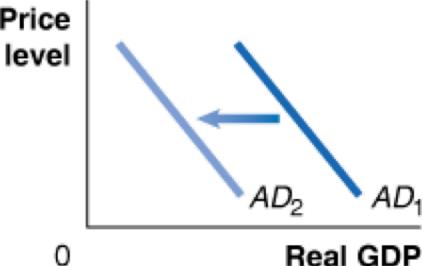
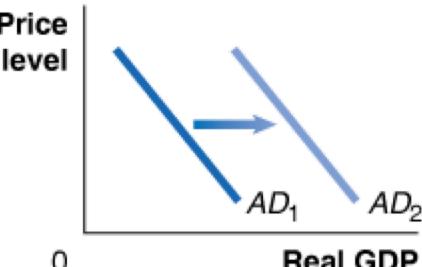
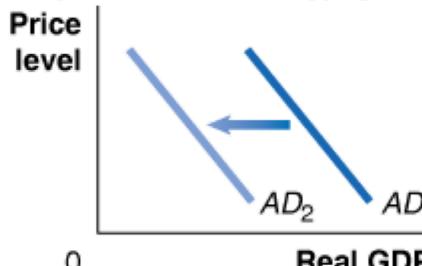
# AD Shifts: Changes in Government Policy

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- Changes in government policies could shift aggregate demand
- Two categories of government policies:
  1. **Monetary policy**: Central bank manages the money supply and interest rates
    - If it causes interest rates to rise, investment spending will fall
  2. **Fiscal policy**: Government collects taxes ( $T$ ) and spends ( $G$ ) on goods and services
    - Decisions about  $T$  and  $G$

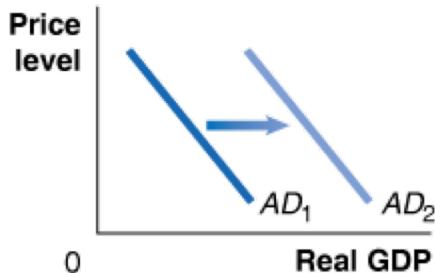
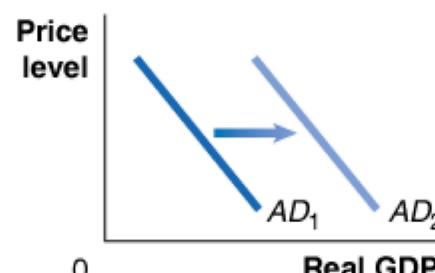
# AD Shifts: Changes in Government Policy

## Variables That Shift the Aggregate Demand Curve

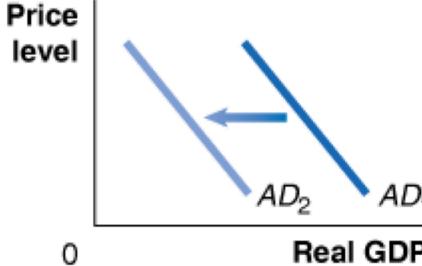
AN INCREASE IN ...	SHIFTS THE AGGREGATE DEMAND CURVE ...	BECAUSE ...
interest rates	 A graph with 'Price level' on the vertical axis and 'Real GDP' on the horizontal axis. Two downward-sloping aggregate demand curves are shown: the initial one is labeled $AD_1$ and the new one after a shift is labeled $AD_2$ . A blue arrow points from $AD_1$ to $AD_2$ , indicating a leftward shift.	higher interest rates raise the cost to firms and households of borrowing, reducing consumption and investment spending.
government purchases	 A graph with 'Price level' on the vertical axis and 'Real GDP' on the horizontal axis. Two downward-sloping aggregate demand curves are shown: the initial one is labeled $AD_1$ and the new one after a shift is labeled $AD_2$ . A blue arrow points from $AD_1$ to $AD_2$ , indicating a rightward shift.	government purchases are a component of aggregate demand.
personal income taxes or business taxes	 A graph with 'Price level' on the vertical axis and 'Real GDP' on the horizontal axis. Two downward-sloping aggregate demand curves are shown: the initial one is labeled $AD_1$ and the new one after a shift is labeled $AD_2$ . A blue arrow points from $AD_1$ to $AD_2$ , indicating a leftward shift.	consumption spending falls when personal taxes rise, and investment falls when business taxes rise.

# AD Shifts: Changes in Expectations

## Variables That Shift the Aggregate Demand Curve

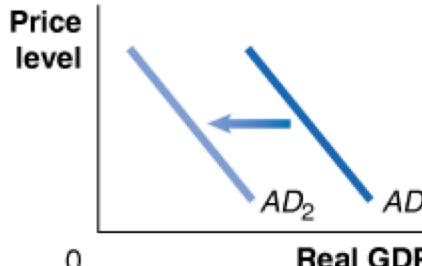
AN INCREASE IN ...	SHIFTS THE AGGREGATE DEMAND CURVE ...	BECAUSE ...
households' expectations of their future incomes	 A graph illustrating a rightward shift in the Aggregate Demand (AD) curve. The vertical axis is labeled "Price level" and the horizontal axis is labeled "Real GDP". The initial downward-sloping AD curve is labeled $AD_1$ . A second, parallel downward-sloping AD curve to its right is labeled $AD_2$ . A blue arrow points from $AD_1$ to $AD_2$ , indicating a shift to the right.	consumption spending increases.
firms' expectations of the future profitability of investment spending	 A graph illustrating a rightward shift in the Aggregate Demand (AD) curve. The vertical axis is labeled "Price level" and the horizontal axis is labeled "Real GDP". The initial downward-sloping AD curve is labeled $AD_1$ . A second, parallel downward-sloping AD curve to its right is labeled $AD_2$ . A blue arrow points from $AD_1$ to $AD_2$ , indicating a shift to the right.	investment spending increases.

# AD Shifts: Changes Relative to Foreign Variables

AN INCREASE IN ...	SHIFTS THE AGGREGATE DEMAND CURVE ...	BECAUSE ...
the growth rate of domestic GDP relative to the growth rate of foreign GDP		imports will increase faster than exports, reducing net exports.

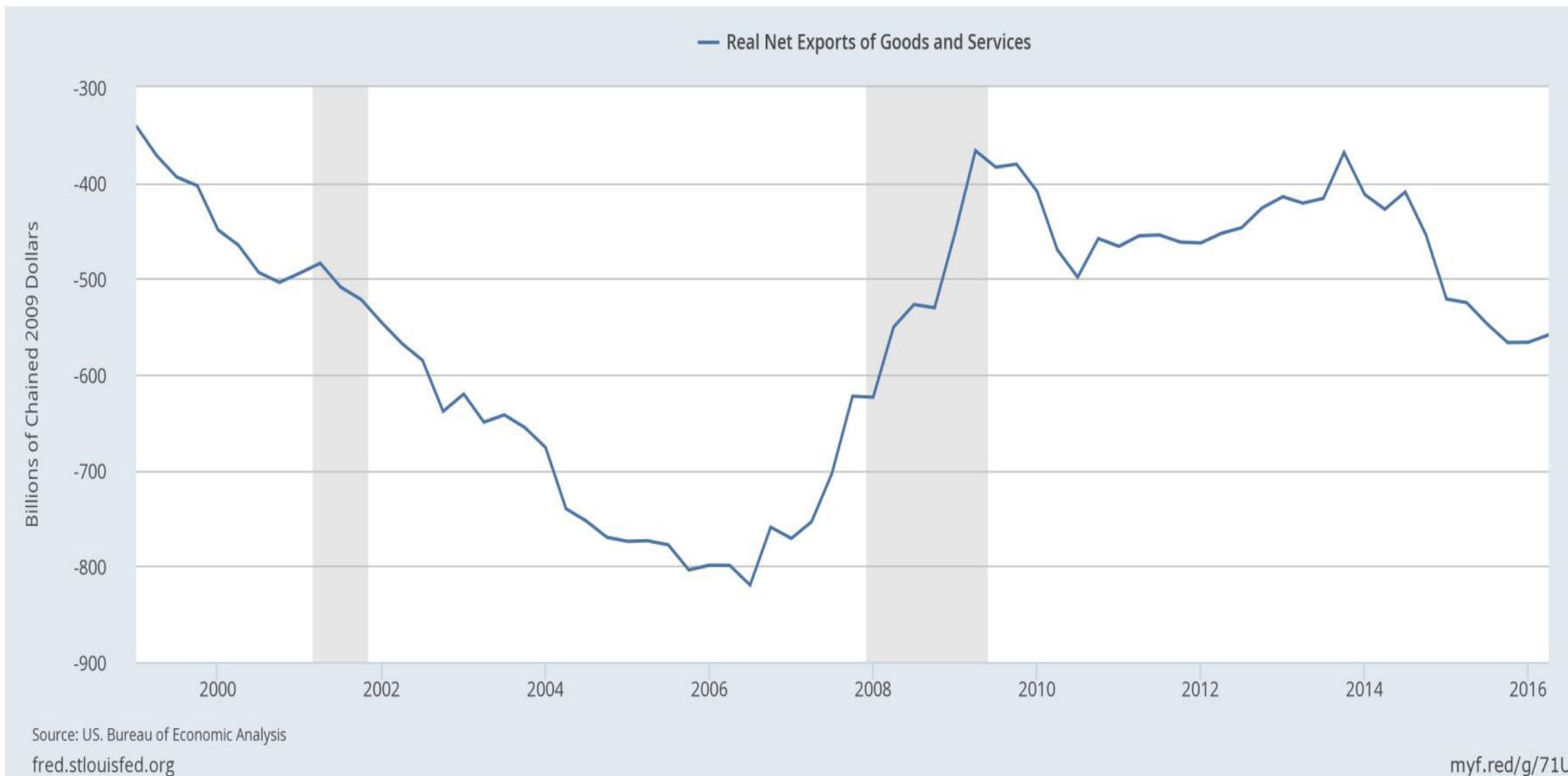
- In 2015, many emerging economies fell into **recessions**
  - Their incomes and spending shrunk
  - Their **imports of US goods fell**

# AD Shifts: Changes Relative to Foreign Variables

AN INCREASE IN ...	SHIFTS THE AGGREGATE DEMAND CURVE ...	BECAUSE ...
the exchange rate (the value of the dollar) relative to foreign currencies		imports will rise and exports will fall, reducing net exports.

- In 2015, Brazil's **currency rate fell sharply**
  - US exports became more expensive, so foreigners bought less of them

# US Net Exports



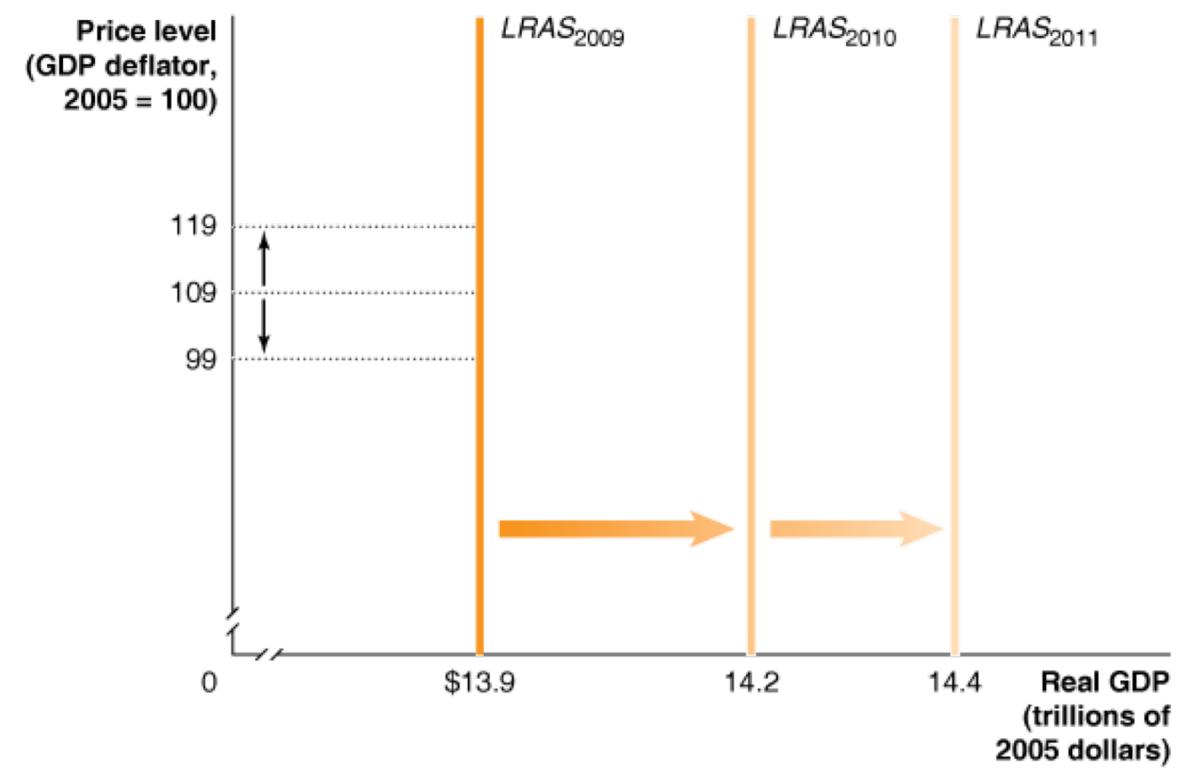
# Aggregate Supply and Time Frame

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- Aggregate Supply refers to the quantity of G&S that firms are willing and able to supply
- The relationship between this quantity and the price level is **different in the long and short run**
- So we will develop **both** curves: short-run Aggregate Supply and long-run Aggregate Supply
  - They show the relationship between the price level and quantity of real GDP supplied in different time frames

# The Long-Run Aggregate Supply Curve

- In the long run, the level of real GDP is determined by the number of workers, the level of technology, and the capital stock (factories, machinery, etc.)
  - **None of these elements is affected by the price level**
- So the long-run AS curve is a **vertical line**, at the level of **potential or full-employment GDP**



# The Vertical Long-Run Supply Curve

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- In the **short run**, there is evidence that an economy **can produce more**, if you allow a **rising price level**
- But the **long-term** trajectory for output **cannot** be lifted by allowing prices to rise faster
  - You can't get more output just by allowing more inflation
  - As we learned:

$$LTSG = \textit{Labor Productivity Growth} + \textit{Labor Force Growth}$$

# The Short-Run Aggregate Supply Curve

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- The short-run Aggregate Supply curve is upward sloping
  - As the overall price level rises, the level of output rises
- Why the SRAS curve is upward sloping?
  - Who provides us with the output (the supply)?

Firms

- What drives firm decisions?

Profits

- The simplest profit formula?

**Profit = Revenues -Costs**

# Profits per Item Sold

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- Profits = Revenues - Costs
- Profits/pizza = (Revenues/pizza) – (Cost/pizza)
  - Revenues/pizza = Price of the pizza
  - Cost/pizza: 80% are labor costs (wages)
- Wages are sticky
- If the price level is rising and wages are sticky, you make **more money per unit sold**

# Why Do You Increase Production?

		pizzas	cost per worker	non labor costs per pizza		total non-labor costs	total costs	price per pizza	cost per pizza	profit or loss
# of ovens	# of workers	sold per day	per day	per day	labor costs	costs	costs			
1	5	50	\$80	\$2	\$400	\$100	\$ 500	\$11	\$ 10.00	\$1.00
1	8	65	\$80	\$2	\$640	\$130	\$ 770	\$11	\$ 11.85	(\$0.85)
1	8	65	\$80	\$2	\$640	\$130	\$ 770	\$15	\$ 11.85	\$3.15

- If I can raise my prices and not pay my people more, it's profitable to make more pizza

# So Why the SRAS Curve is Upward Sloping?

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- Contracts make some wages and prices “**sticky**”
  - Prices and wages are said to be “sticky” when they do not respond quickly to changes in demand or supply
- Firms are often slow to adjust wages
  - Annual salary reviews are “normal”
  - Also, firms dislike cutting wages—it’s bad for morale
- Other situations of sticky prices?
  - Magazine prices, menu costs

# Shifts in the SRAS Curve

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- Supply shock: Unexpected event that causes SRAS curve to shift
- SRAS shifts when:
  - Input prices change
    - ❖ Nominal wages
    - ❖ Commodity (e.g. natural resource) prices
  - Factors of production change
  - Technology changes

# SRAS Shifts: Change in Nominal Wages

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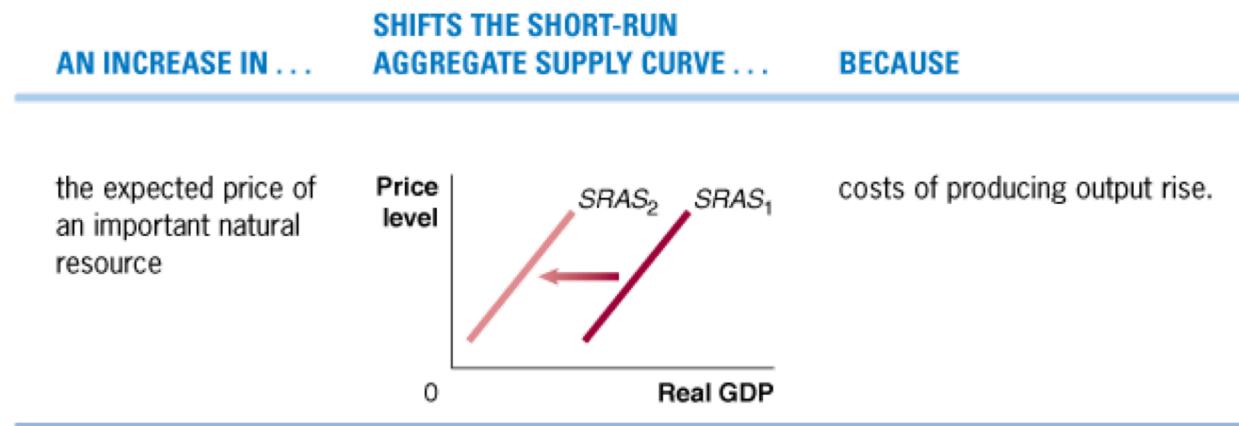
- Recall: Shifting the SRAS curve requires to look at the change in relationship between a given overall price level and the quantity produced
- What happens if the government raises the minimum wage?
  - What happens if you must pay \$100/day instead of \$80/day?

# What Happens to Pizza Output?

# of ovens	# of workers	pizzas sold	cost per worker	non labor costs per pizza per day	total labor costs	non-labor costs	total costs	price per pizza	cost per pizza	profit or loss per pizza	total profits
		per day	per day	labor costs	costs	costs	costs	pizza	pizza	per pizza	profits
1	5	50	\$80	\$2	\$400	\$100	\$ 500	\$11	\$ 10.00	\$1.00	\$50.00
1	8	65	\$80	\$2	\$640	\$130	\$ 770	\$11	\$ 11.85	(\$0.85)	-\$55.00
1	8	65	\$80	\$2	\$640	\$130	\$ 770	\$14	\$ 11.85	\$2.15	\$140.00
1	8	65	\$100	\$2	\$800	\$130	\$ 930	\$14	\$ 14.31	(\$0.31)	-\$20.00
1	5	50	\$100	\$2	\$500	\$100	\$ 600	\$14	\$ 12.00	\$2.00	\$100.00

# SRAS Shifts: Unexpected Changes in Prices of Resources

- Unexpected input price increases would shift SRAS to the left
  - Example: Oil prices increase suddenly
  - With no change in final goods prices, same as an increase in labor costs
  - Produce less at a given price so SRAS shifts to the left



# SRAS Shifts: Change in Technology

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- What happens if we experience a big change in labor productivity (a technological change)?
- Let's go back to the pizza parlor:

		pizzas sold per day	pizzas per worker
# of ovens	# of workers		
1	5	50	10
1	8	64	8
1	8	80	10

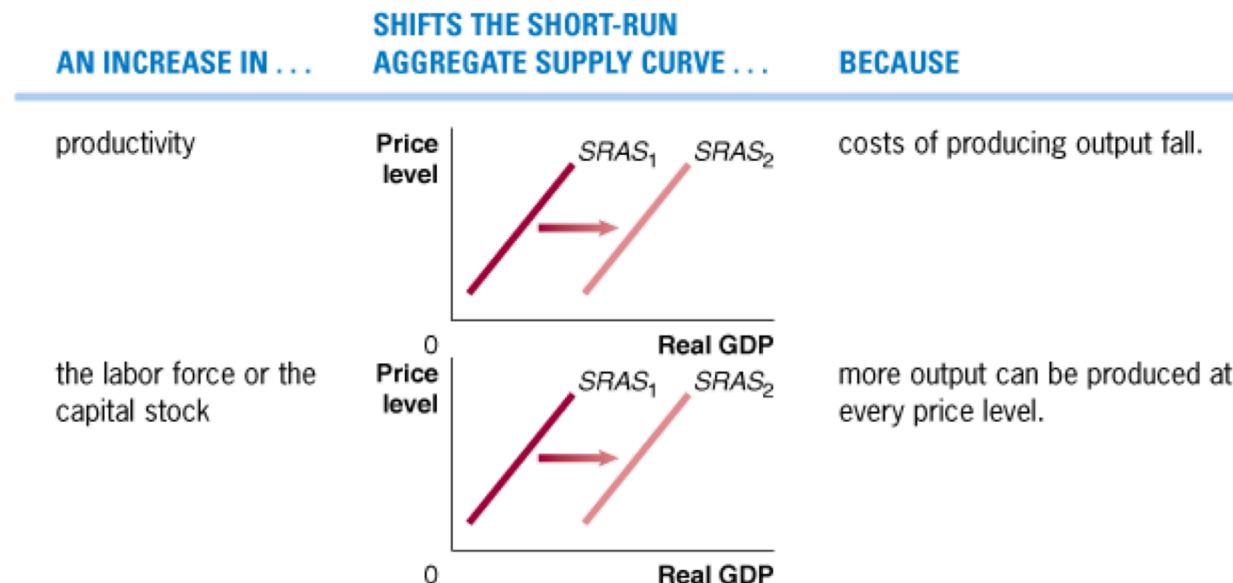
# SRAS Shifts: Change in Technology

		pizzas	cost per	non labor		total				profit	
# of	# of	sold	worker	costs per	total	non-labor	total	price per	cost per	or loss	total
ovens	workers	per day	per day	pizza per day	labor costs	costs	costs	pizza	pizza	per pizza	profits
1	8	64	\$100	\$2	\$800	\$128	\$ 928	\$14	\$ 14.50	(\$0.50)	-\$32.00
1	8	80	\$100	\$2	\$800	\$160	\$ 960	\$14	\$ 12.00	\$2.00	\$160.00

- Labor productivity jumped → Cost/pizza fell
- We increase pizza production and still are profitable

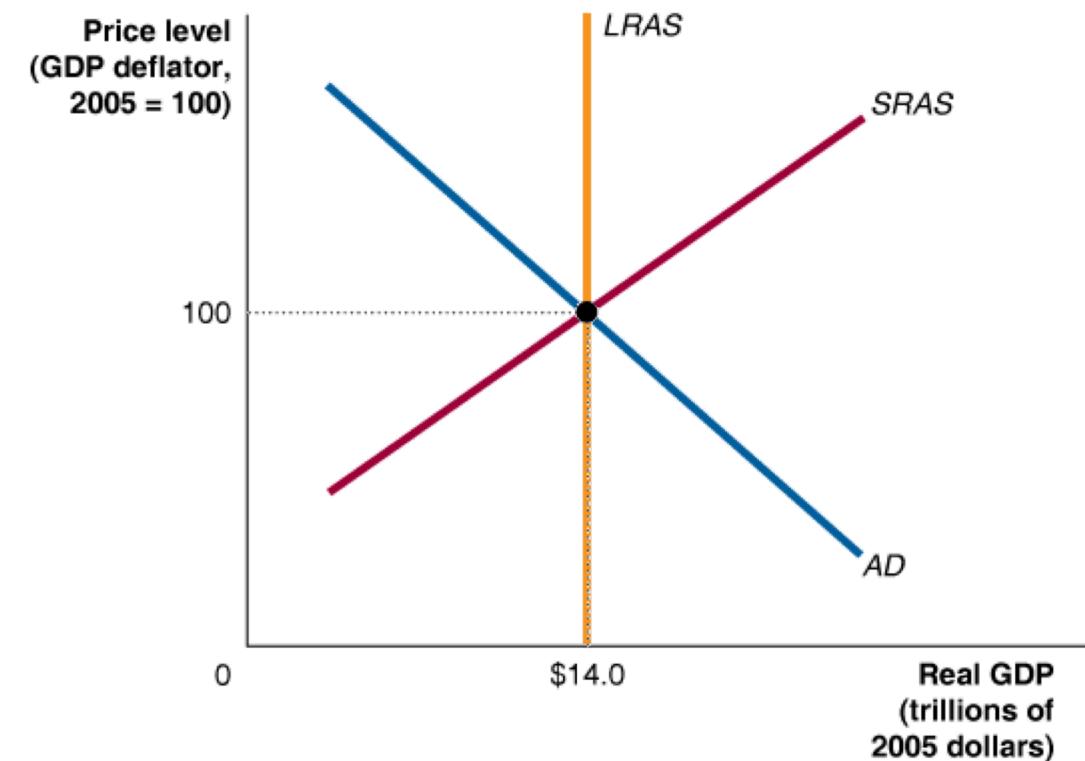
# SRAS Shifts: Technology and Factors of Production

- **Improvements in technology** allow productivity to improve, and hence level of production at any given price level increases
- An increase in the **availability of the factors of production**, like labor and capital, allows more production at any price level



# Long-Run Macroeconomic Equilibrium

- In the long-run, we expect the economy to produce at the level of **potential GDP**—i.e., the LRAS level
- So **long-run macroeconomic equilibrium** occurs when the AD and SRAS curves intersect at the LRAS level



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# Analysis of Shocks to Aggregate Demand and Aggregate Supply

# Static Model

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- For simplicity, assume:
  1. No inflation; the current and expected-future price level is 100
  2. No long-run growth; i.e. the LRAS curve is not moving
- These assumptions will help us analyze **recessions**, **expansions** and **supply shocks**
- We will see **why** long-run macroeconomic equilibrium cannot occur at any other level of output (other than potential GDP)

# Characterizing Changes in Key Variables as Shocks

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- Why call them shocks?
- Most economic models are **equilibrium seeking**
- When something occurs outside of the forces that drive the model, it **SHOCKS** the system and the model pushes toward a different equilibrium

# Types of AD Shocks

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- Changes in variables that determine the position of the AD curve

$\Delta$  HH expectations  $\rightarrow$   $\Delta$  Autonomous consumption

$\Delta$  Personal taxes  $\rightarrow$   $\Delta Y_d \rightarrow \Delta C$

$\Delta$  Profit expectations  $\rightarrow$   $\Delta$  Investment

$\Delta$  Interest Rates  $\rightarrow$   $\Delta$  Investment

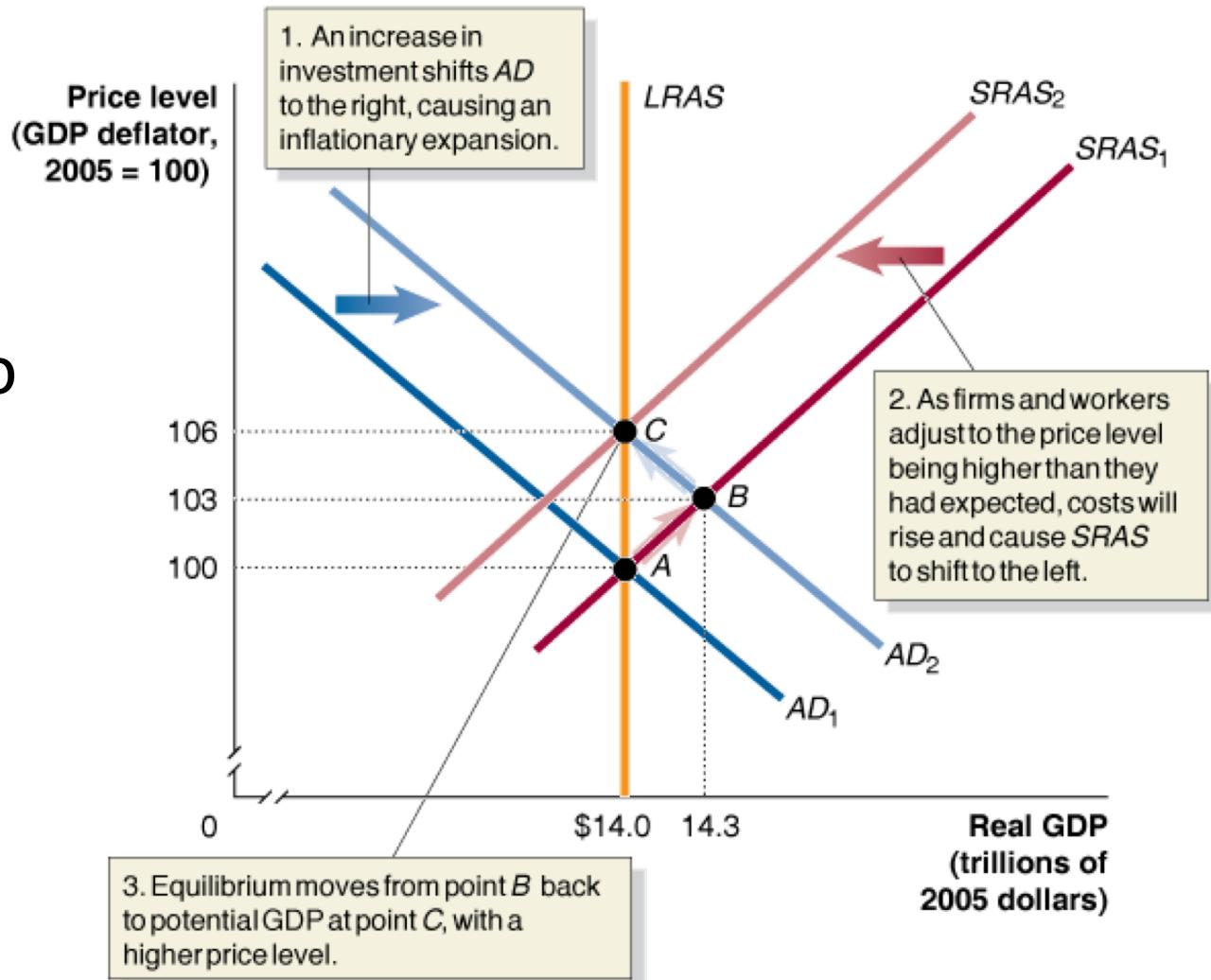
# Types of AS Shocks

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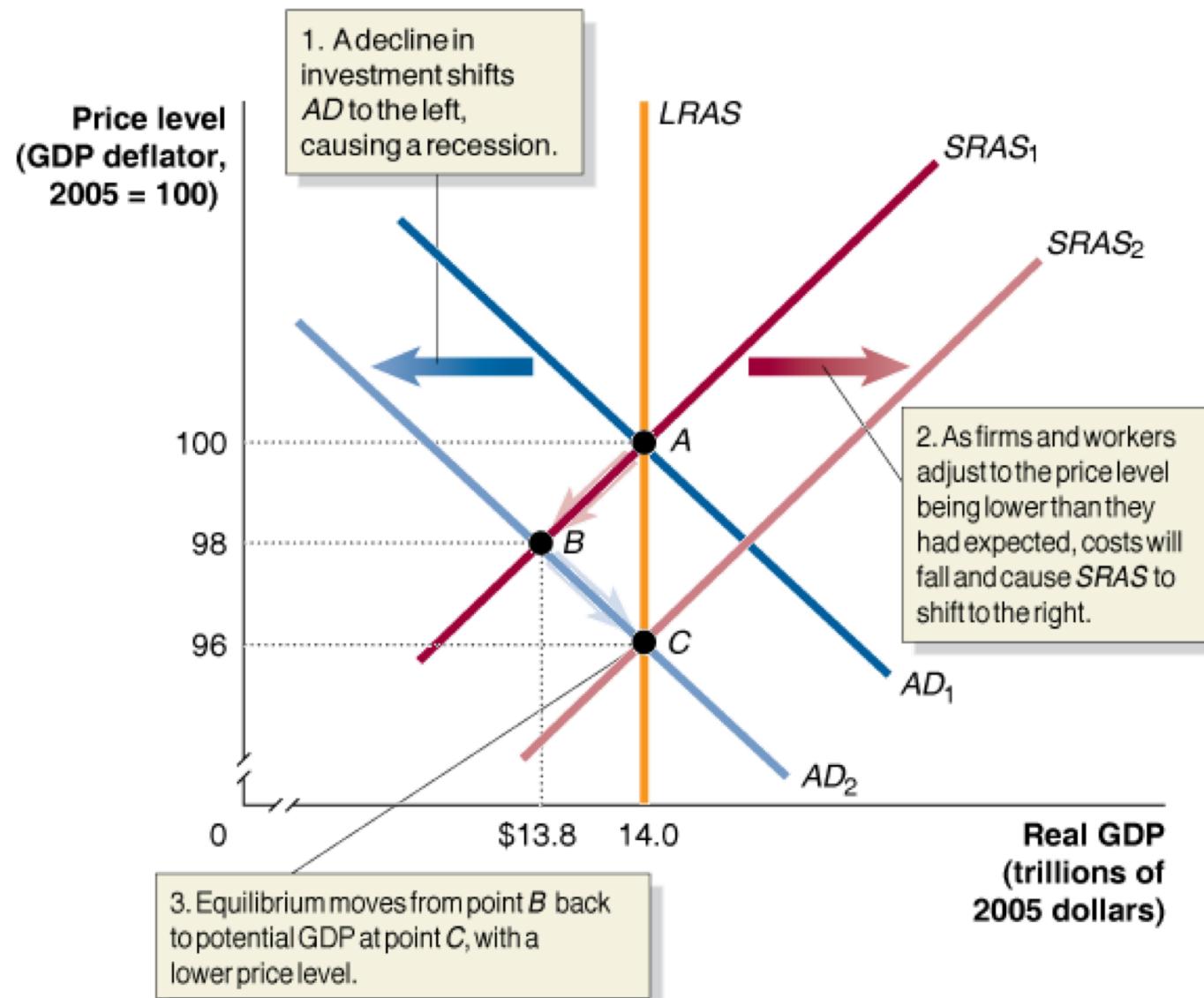
- Changes in variables that determine the position of the AS curve
  - Wages ( $W$ )
  - Productivity ( $Z$ )
  - Capital Stock ( $K$ )
  - Resource Prices ( $RP$ )

# Expansion

- Start in LR equilibrium
- Firms more optimistic → Investment raises → **AD shifts right**
- Unemployment falls below its **natural rate**, forcing employers to pay more
- Increased demand for goods **raises prices**
- Firms and workers raise their expectations about price level → **SRAS shifts left** – restoring LR equilibrium

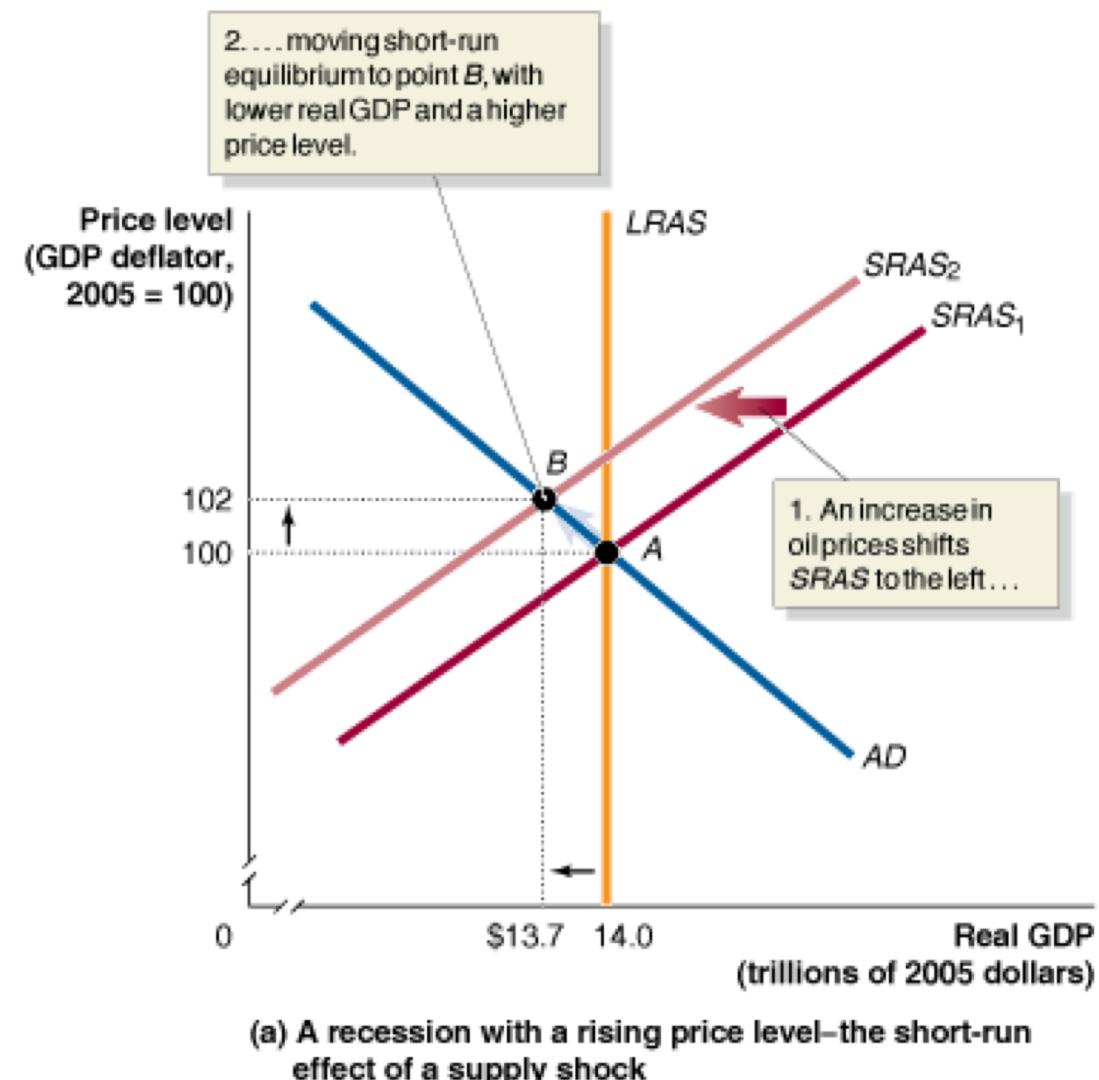


# Recession



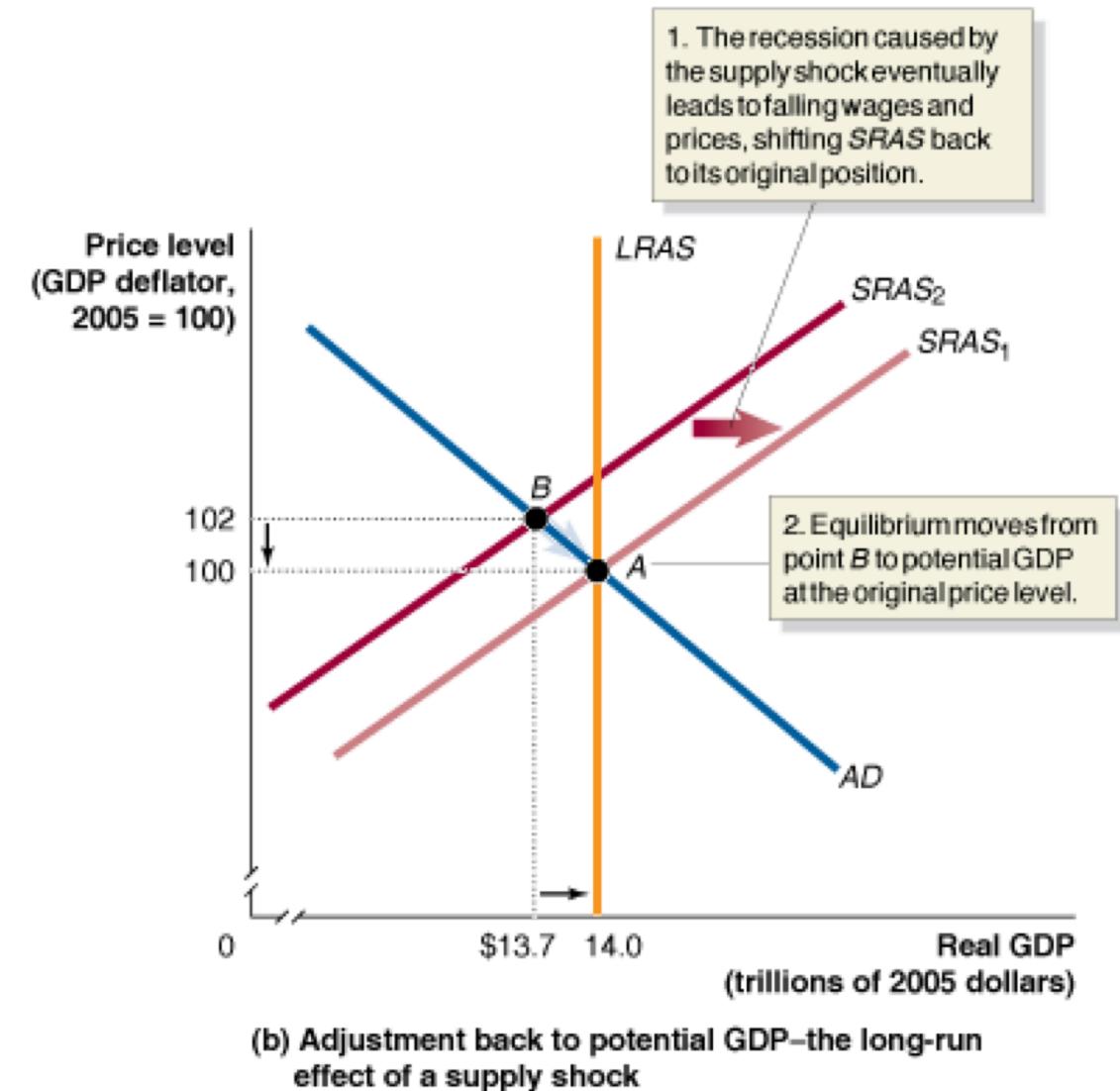
# Supply Shocks

- What happens when we have a Mid-East war?
- **Supply shock:** SRAS of oil shrinks suddenly
- This causes **stagflation**, a combination of inflation and recession, usually resulting from a supply shock

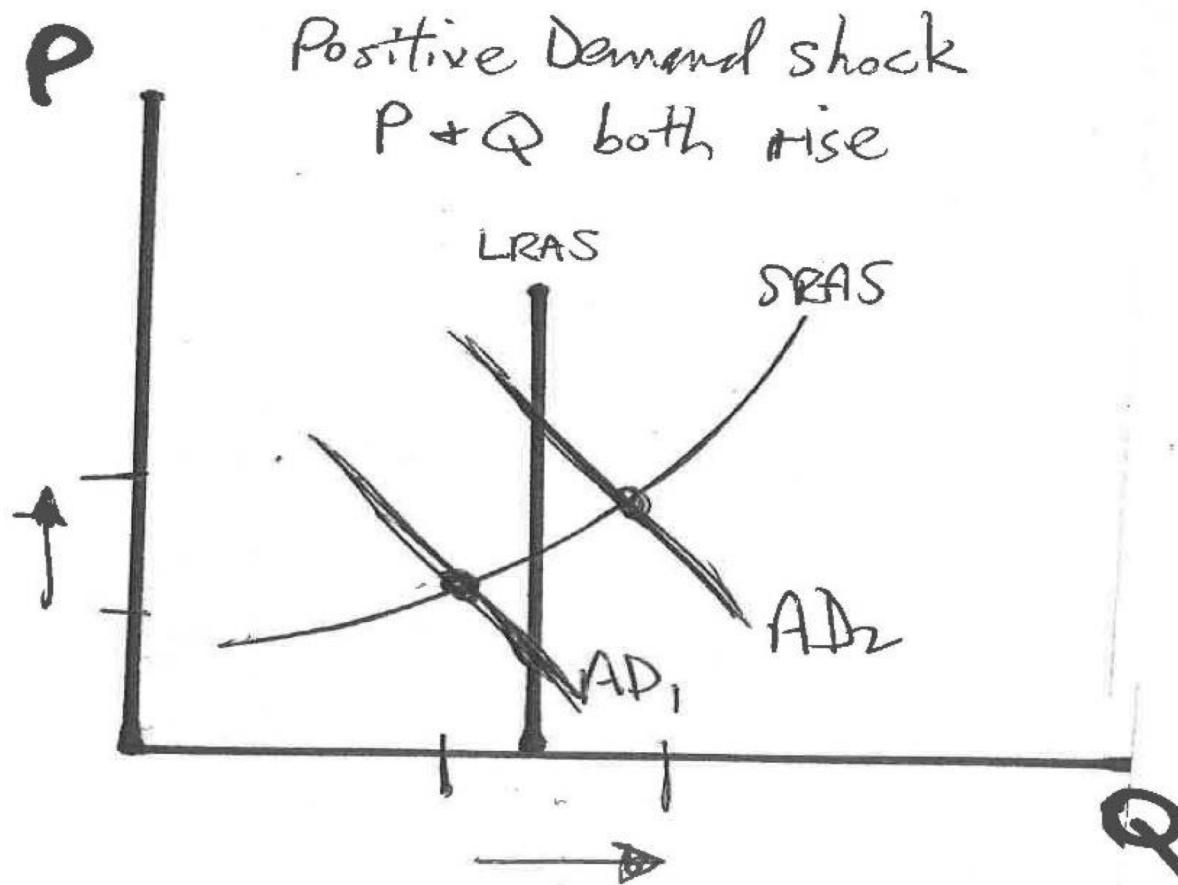


# Adjustment Back to Potential GDP from A Supply Shock

- Lower output + Unsold products (higher inventories, lay off people) → Lower employment
- **Higher unemployment** → Workers accept lower wages → **Firms cut prices** to clear inventories
- Decrease in expected prices → **SRAS moves right** – restoring LR equilibrium



# A Positive Demand Shock May Be A Mixed Blessing



# Dynamic Interpretation

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- Few focus on the price level, or the level of GDP
- $\frac{\Delta P}{\Delta t} = \pi$       The world watches the inflation rate.  
More specifically:
- $\frac{\Delta \pi}{\Delta t}$  = The change in the pace of price changes.
- $\frac{\Delta Y}{\Delta t} = \dot{Y}$        $\dot{Y}$  = real growth rate for the economy
- A Positive demand Shock:

$\pi$  accelerates

$\dot{Y}$  accelerates

# Static vs Dynamic Model

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- Our model of aggregate demand and aggregate supply so far has been **static**, in the sense that:
  - Price levels were constant (no inflation)
  - There was no long-run growth
- We can form a **dynamic** aggregate demand and aggregate supply model by incorporating:
  - Continually-increasing real GDP, shifting LRAS to the right
  - AD also ordinarily shifting to the right
  - SRAS shifting to the right except when workers and firms expect high rates of inflation

# How Policymakers and Businessmen Think About AD-AS

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- We don't have a stable price level
- We have a **stable inflation rate**
- We don't have a stable output level
- We have a **stable growth rate**

# What Constitutes a Dynamic Equilibrium

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- We posited before that

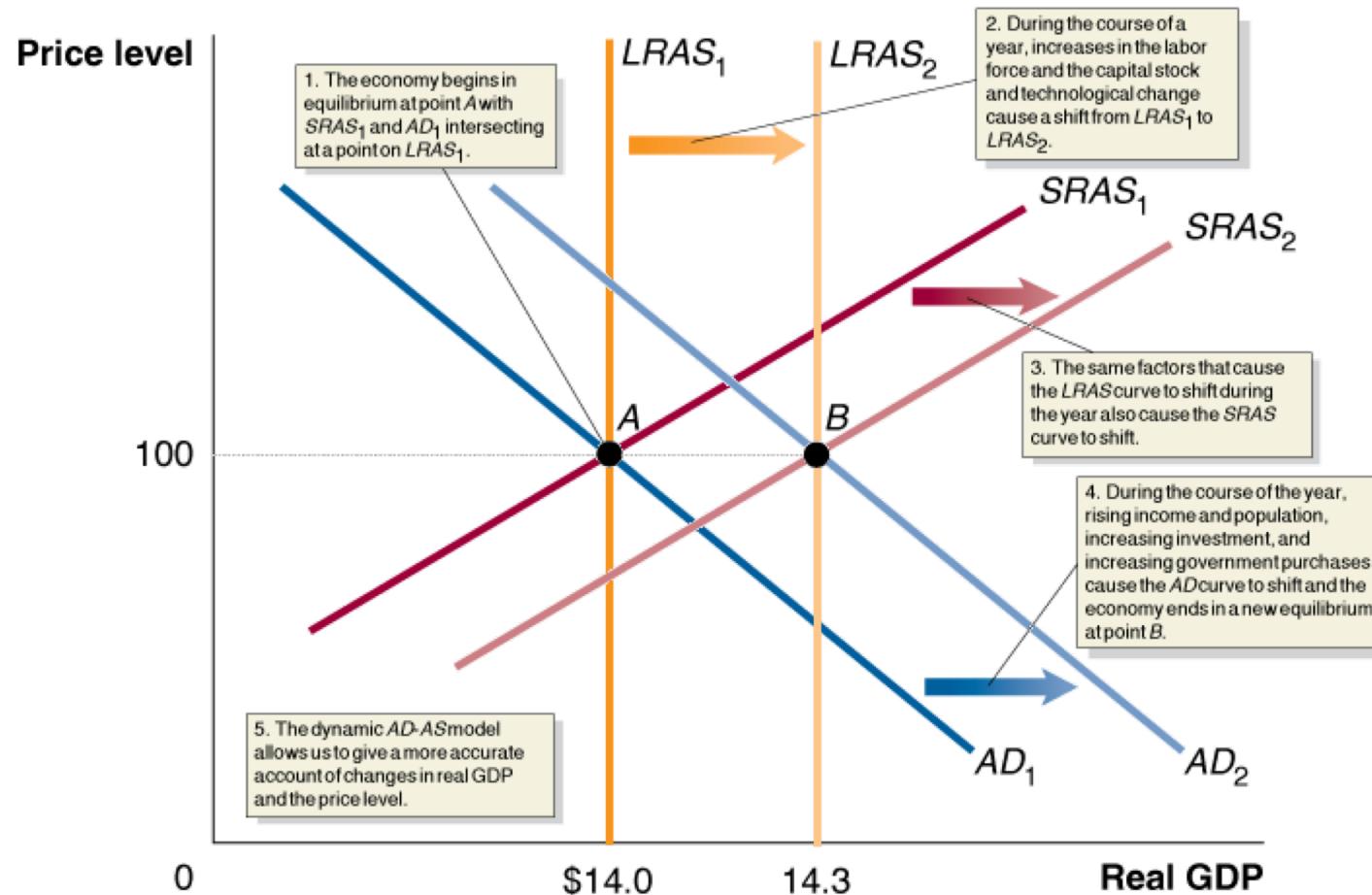
Long-term Sustainable Growth Rate = 2%

- We now posit that

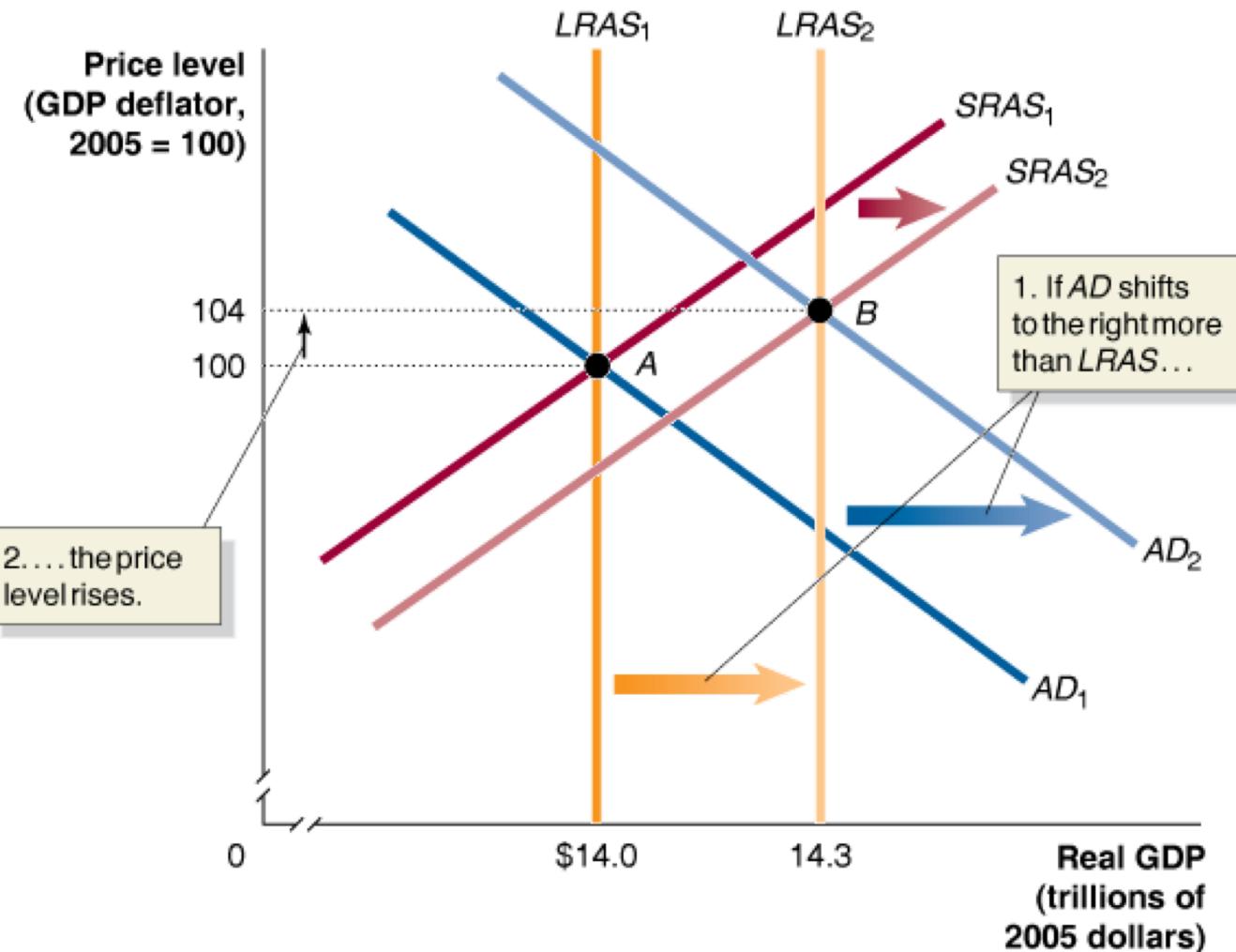
Ideal Inflation Rate = 2%

- **Dynamic equilibrium:** Output and prices are shifting so that **prices** are rising 2% per year and **output** is growing 2% per year

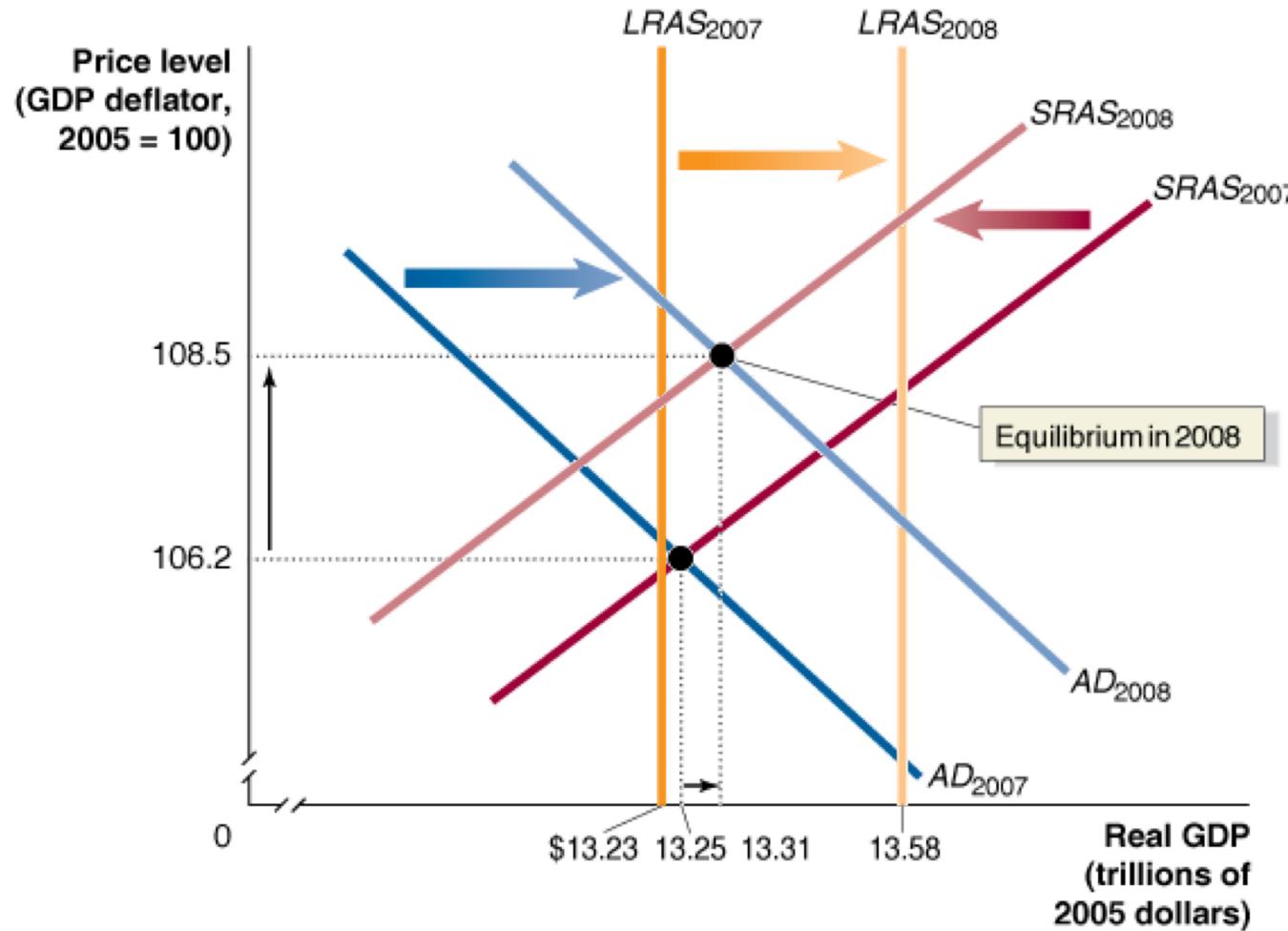
# A Dynamic AD-AS Model



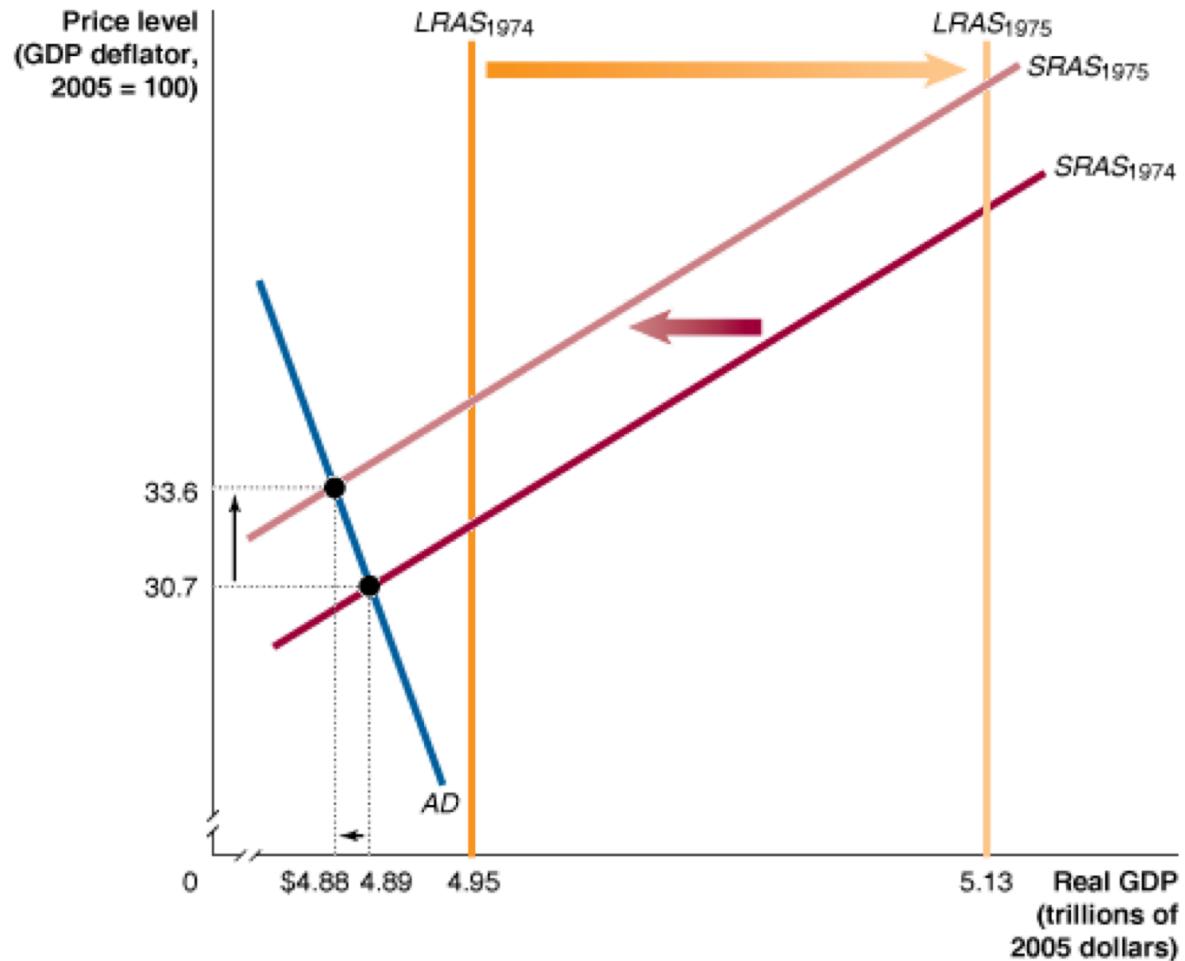
# What Is the Usual Cause of Inflation?



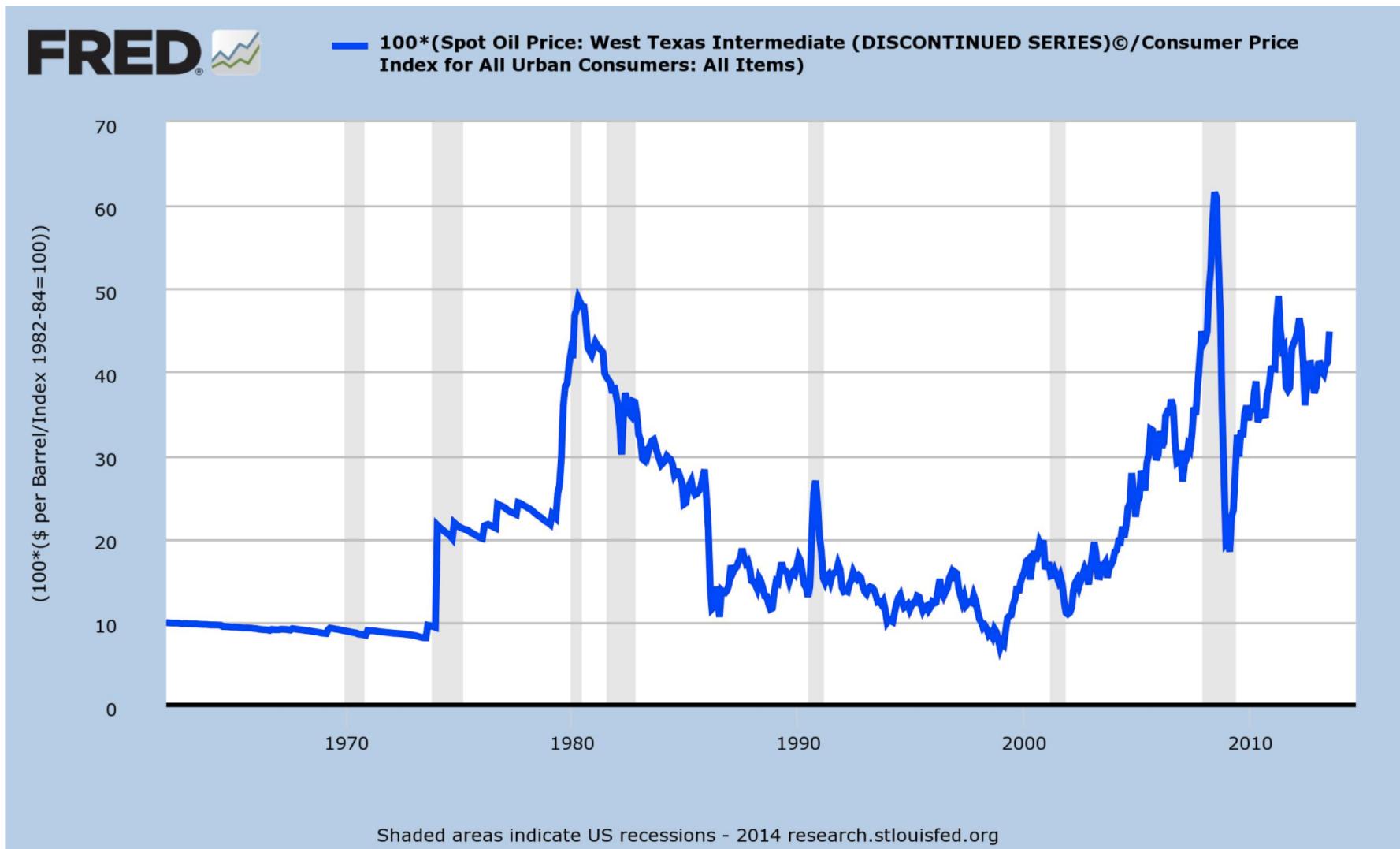
# The Recession of 2007-2009



# The Oil Shock of 1974–1975

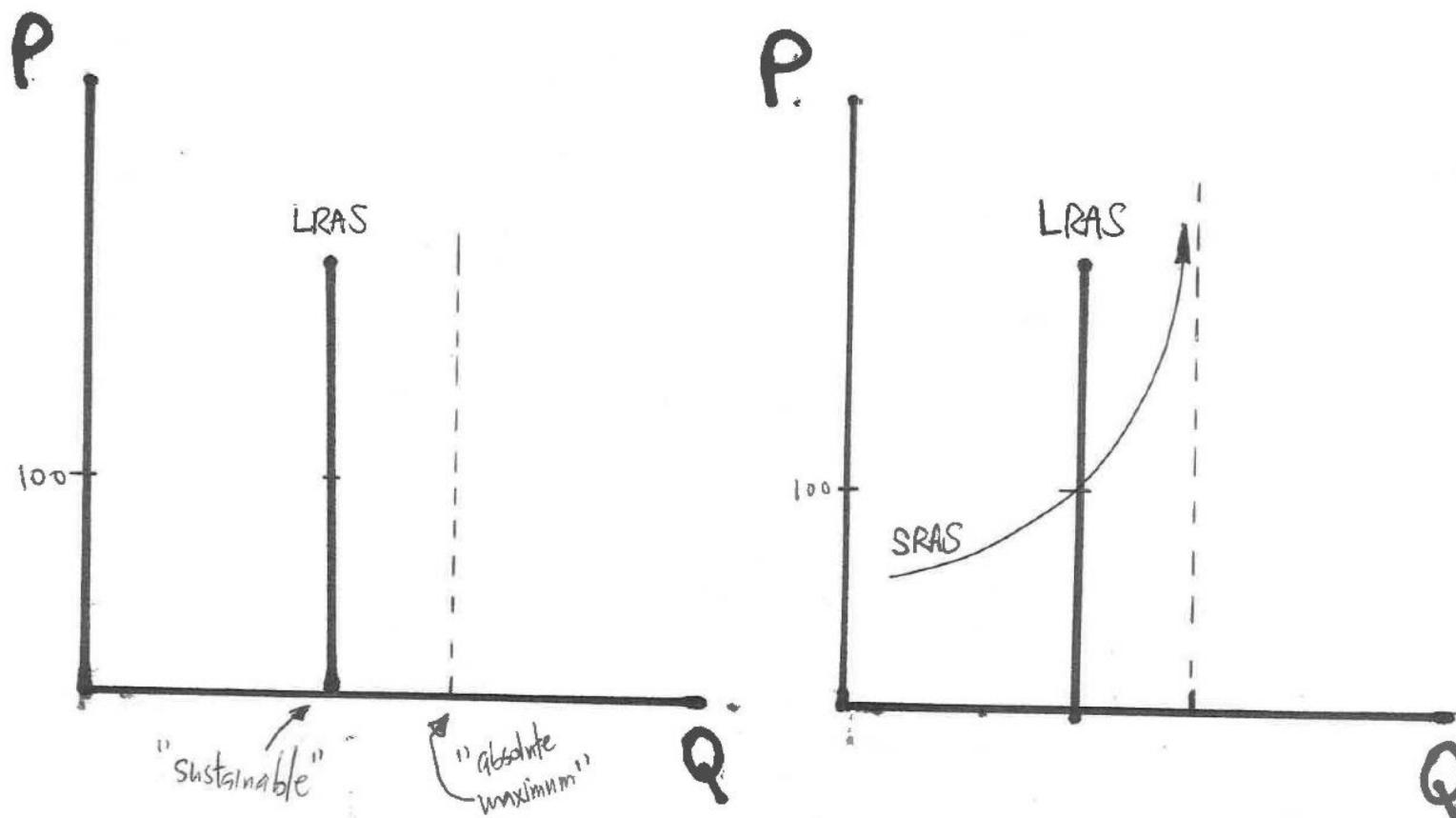


# Oil Shocks: A Part of Every Recession 1970 to 2014



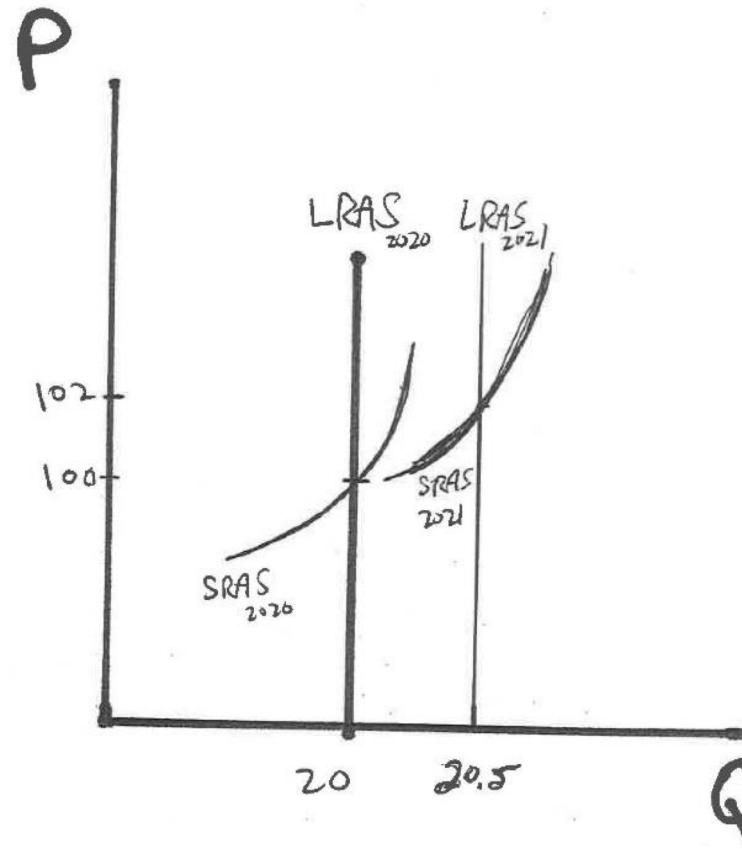
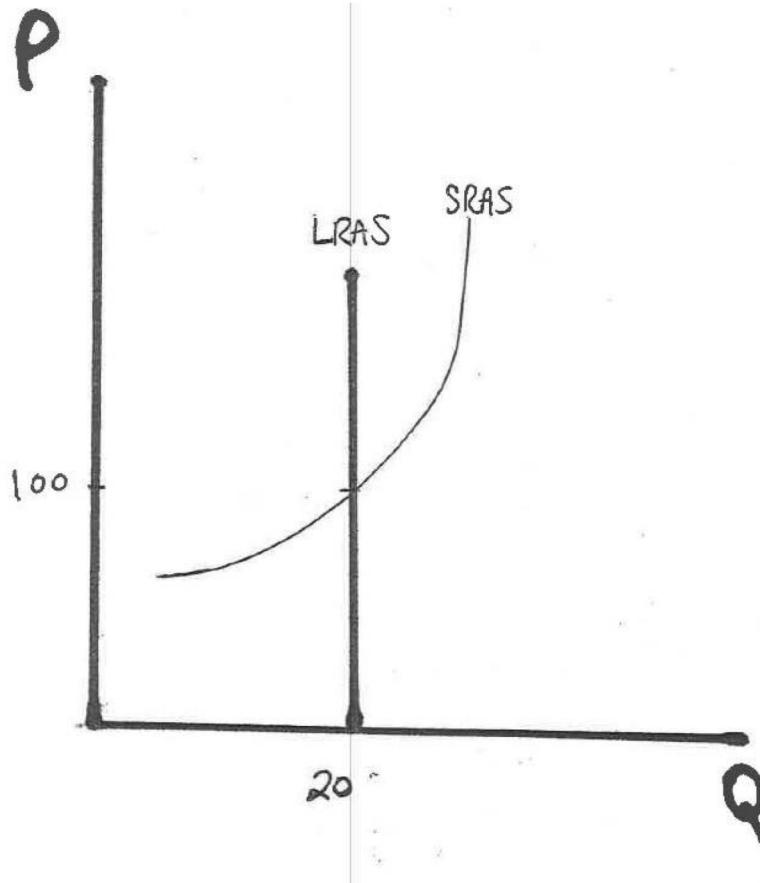
# AS Curve

- A ‘**curve**’ for AS allows us to better characterize economic snapshots



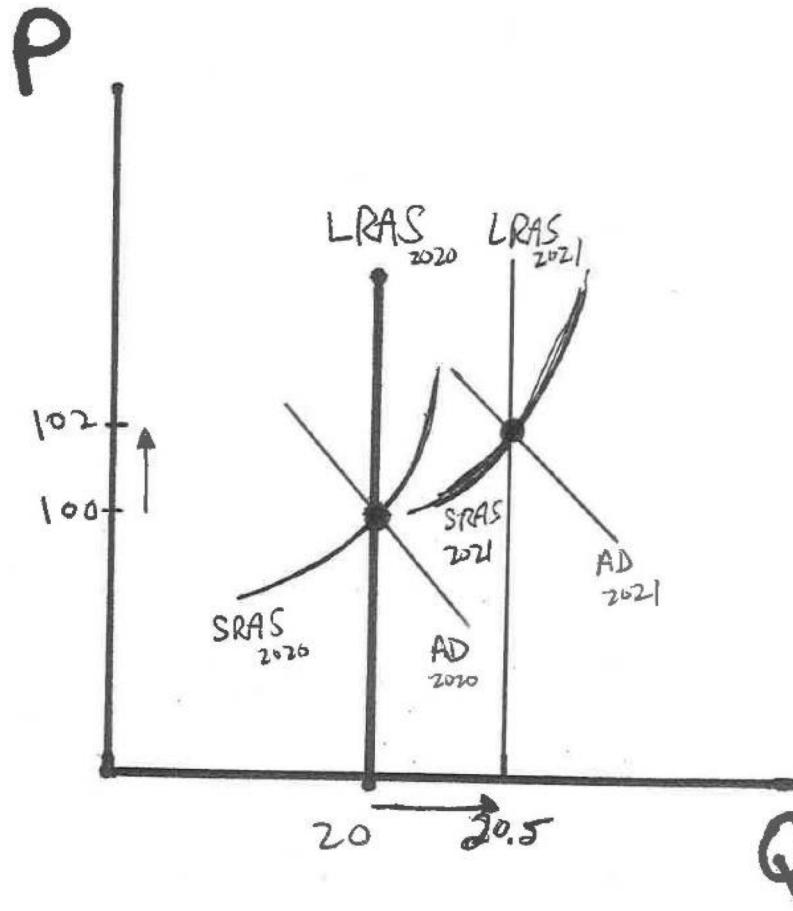
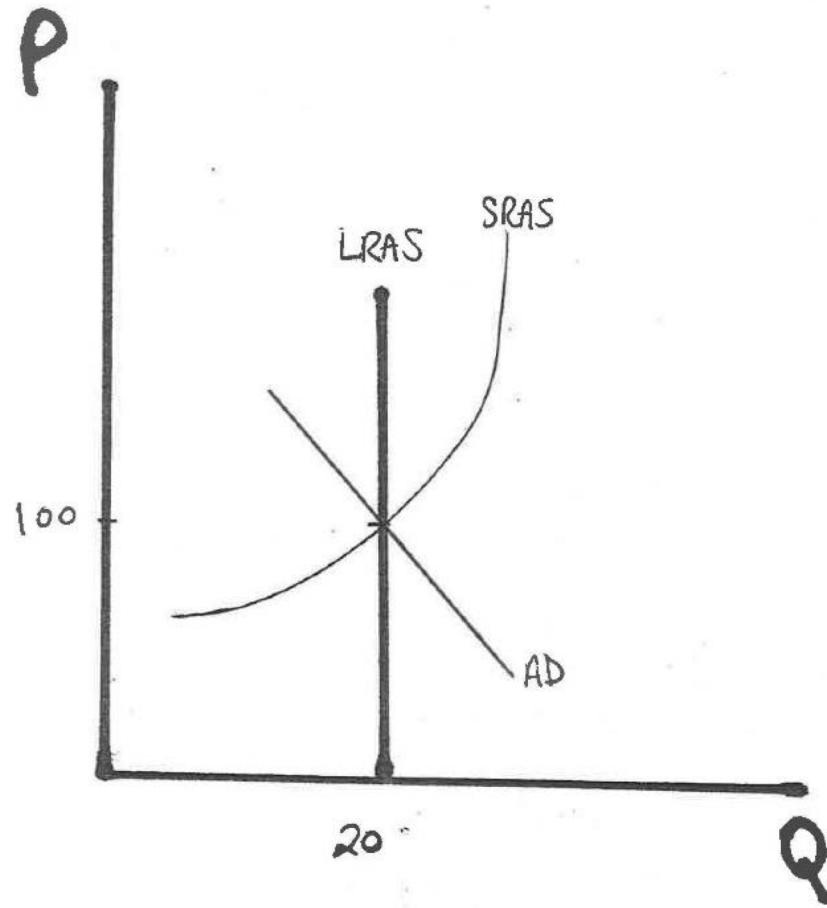
# A Dynamic Depiction: 2020 to 2021

1. Supply potential grows as population lifts **labor force** and **productivity** gains increase output per hour



# A Dynamic Depiction: 2020 to 2021

2. Increased incomes lift **consumption** and **investment** → **AD grows**



# Dynamic Equilibrium

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- Over a year, potential GDP (LRAS) rises by 2%
  - Labor force and productivity
- Over the year,
  - SRAS curve similarly shifts
  - Demand shifts, reflecting larger workforce and more investment
- A 2% rise in prices accompanies this equilibrium shift
  - Inflation expectations well anchored
- Real GDP gains 2%, prices rise 2%
- $\text{LRAS} = \text{SRAS} = \text{AD}$

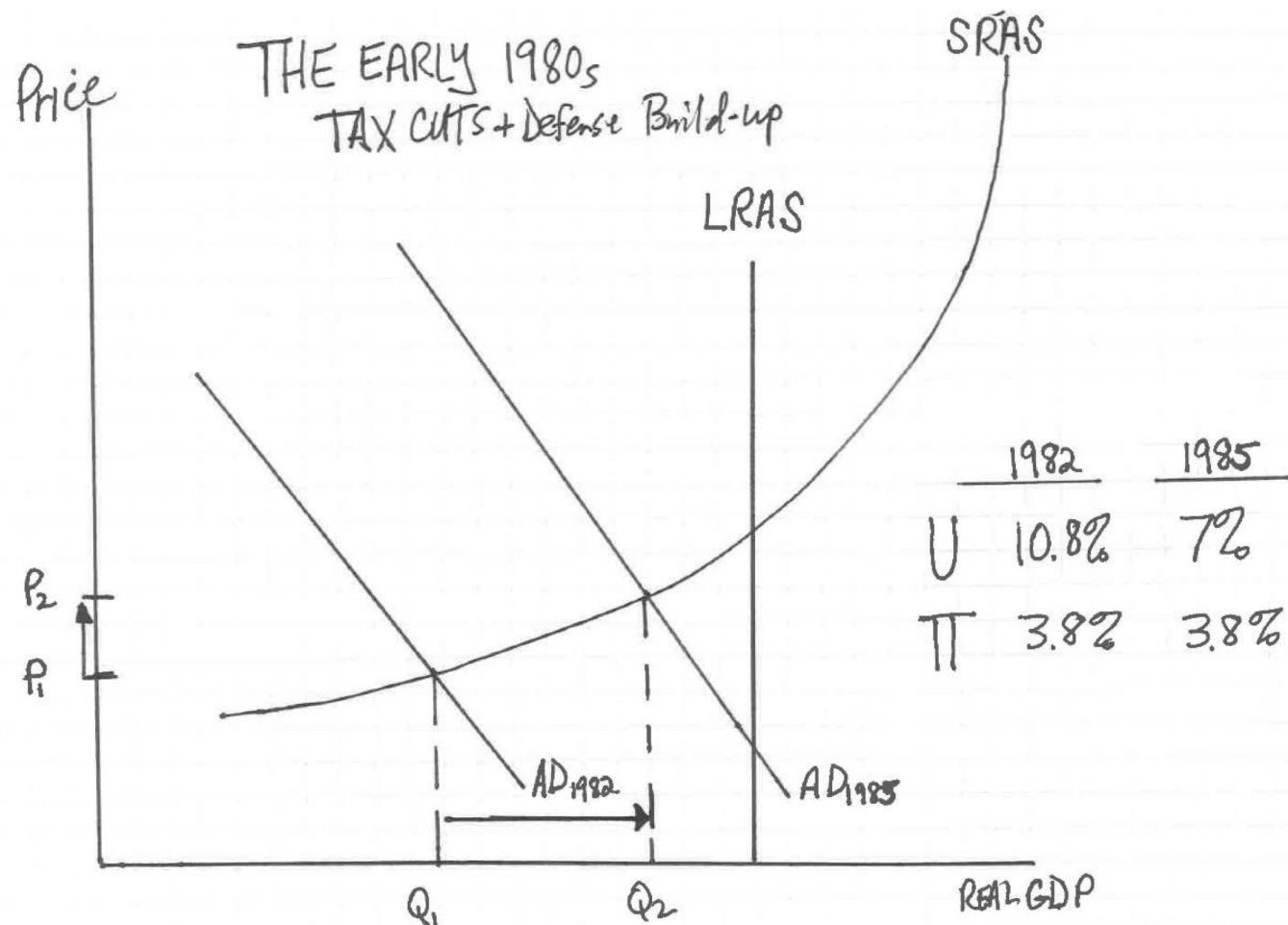
# Shocks Deliver What?

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- The **effects** of demand and supply shocks **depend** in part **on** the **state of the economy before the shock**
- With high U and ample capacity, the supply curve is **flattish**
- With very low U and little room to grow, the supply curve is **very steep**

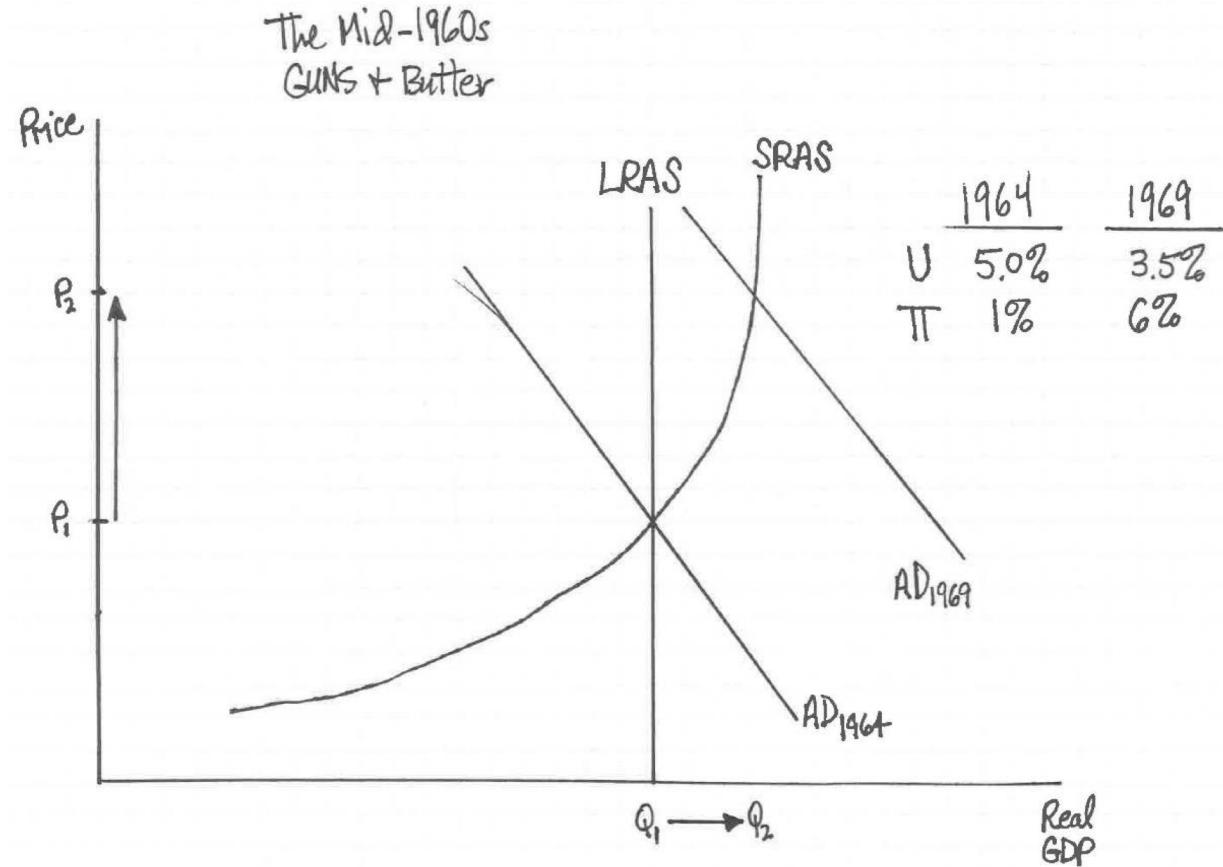
# With Ample Excess Capacity...

- ... a positive demand shock lifts **output meaningfully** and does **little to prices**



# If the Economy Is Operating At Full Employment...

- ... a positive demand shock lifts **output modestly** and **prices leap**



# Types of Aggregate Supply Shocks

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- **Adverse** AS Shocks: Changes in variables that shift AS to the **left**
  - Rising Wages
  - Rising Resource Price
  - Falling Productivity
  - Falling Capital
- **Favorable** AS Shocks: Changes in variables that shift AS to the **right**
  - Falling Wages
  - Falling Resource Price
  - Rising Productivity
  - Rising Capital

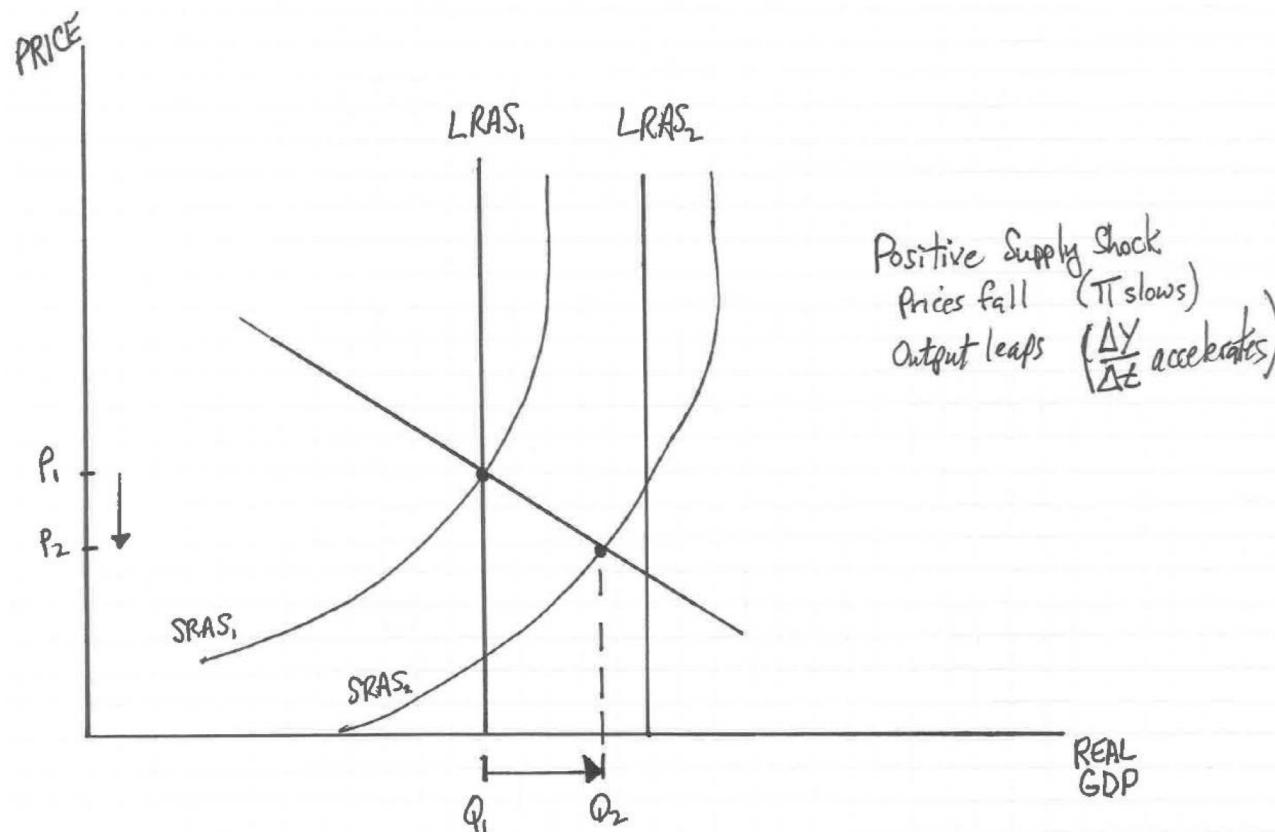
# A Positive Productivity Shock

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- The best news for the long run
- Technology inventions lay the groundwork
- With productivity, we shift people to new endeavors
- That means we have more output, at a given price level
- **AS shifts to the right**
  - Prices Fall
  - Output Rises

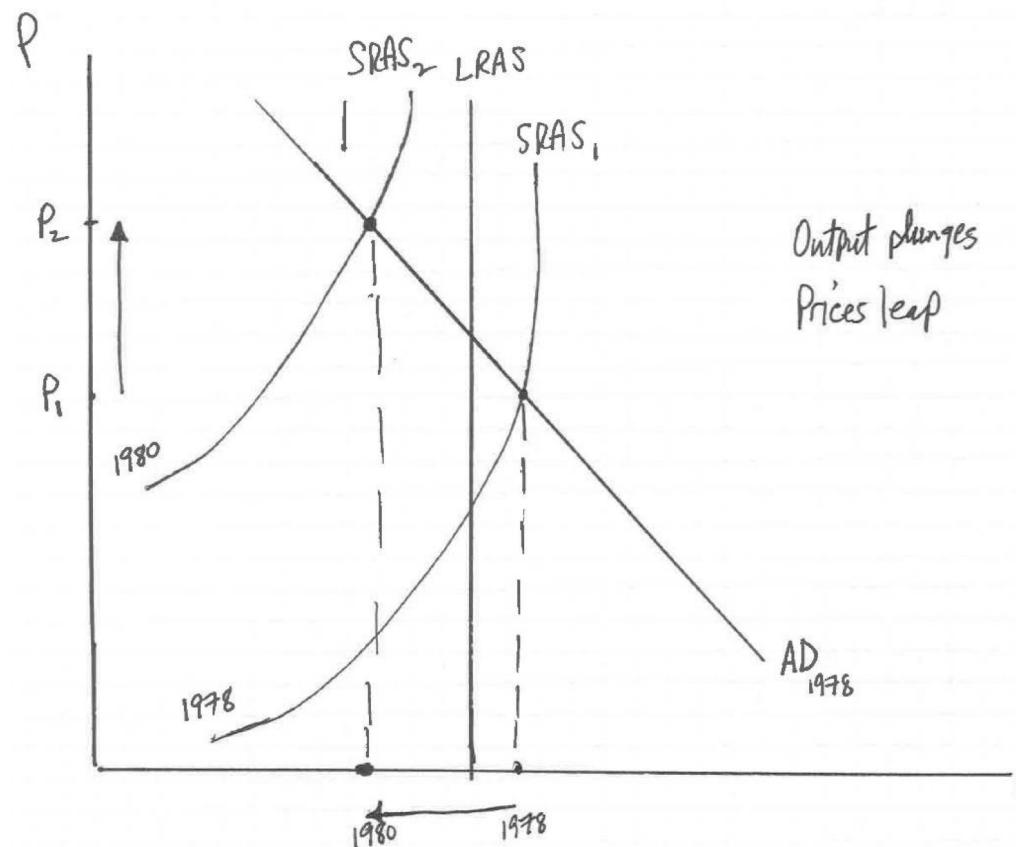
# A Positive Productivity Shock

- A jump in productive capacity allows for **more growth** amid **little price pressure**



# Oil Shock

- OPEC quadrupled oil prices in 1978 → **Inflation surged** and **output plunged**



# AS Shocks

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- Equilibrium price and output move in **opposite directions**
- A **positive** supply shock (e.g. surge in labor force):
  - Prices Fall
  - Output Rises
- An **adverse** supply shock (e.g. oil prices surge):
  - Prices Rise
  - Output Falls

# The Great Recession/Recovery: A Three Part Story

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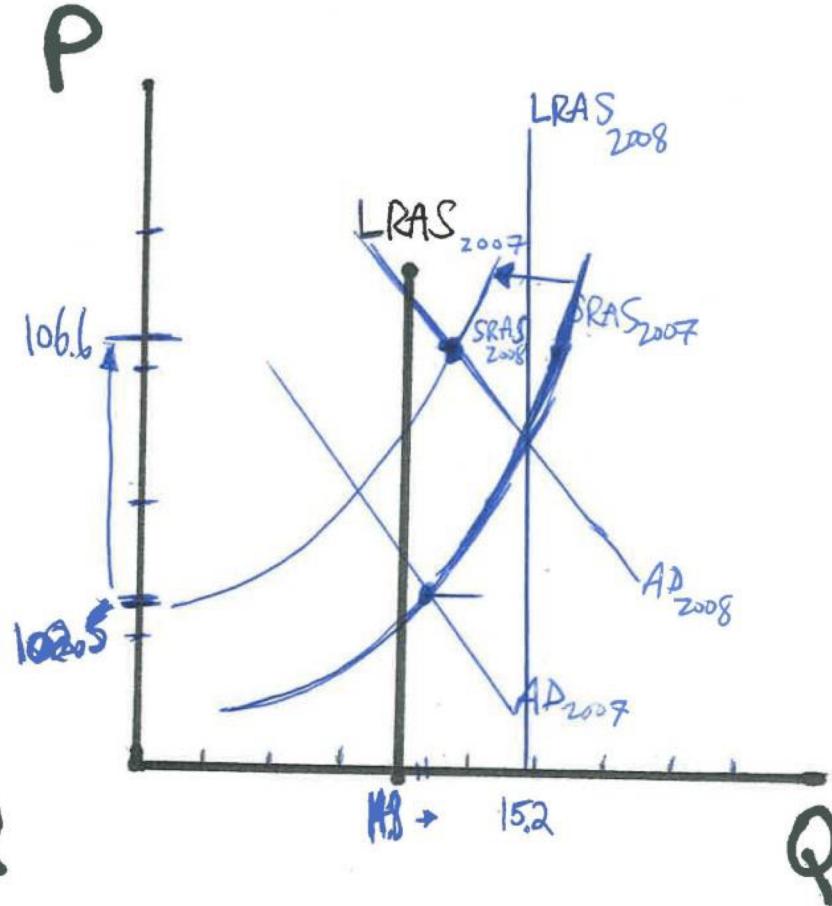
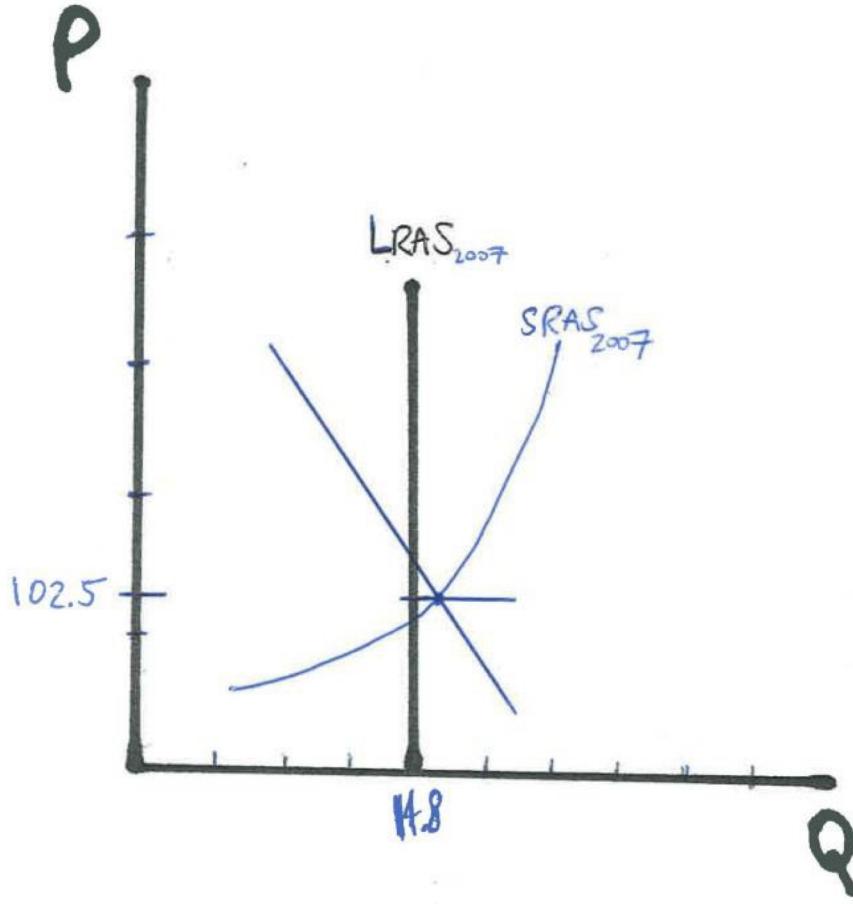
- **Act I:** Q2:2007 to Q2:2008
  - A standard **adverse supply shock** as oil prices surge
- **Act II:** Q2:2008 to Q2:2009
  - An **adverse demand shock** as interest rates surge and consumer and business confidence plunge
- **Act III:** Q2:2009 to Q2:2010
  - A **positive demand reversal** as government spending jumps, confidence rises and interest rates fall

# Bare Facts of the 3-Year Swing for Output and Inflation

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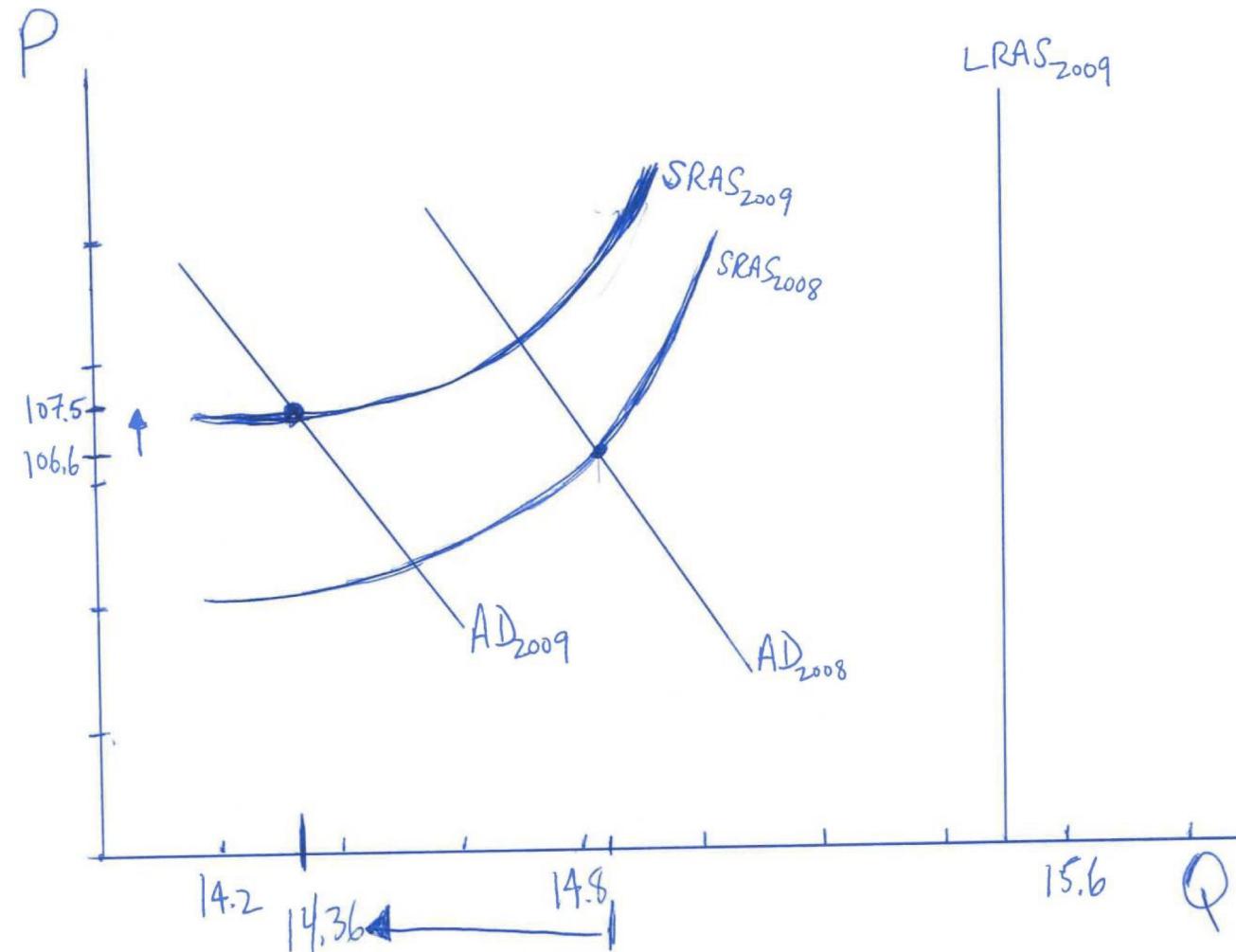
	REAL GDP (\$ BILLIONS)	4-QTR CHANGE	CPI INDEX (LEVEL)	4-QTR CHANGE	Potential GDP	4-QTR CHANGE
Q2:2007	14,839		102.5	2.5%	14,800	
Q2:2008	14,963	0.8%	106.6	4.0%	15,170	2.5%
Q2:2009	14,356	-4.1%	107.5	0.8%	15,473	2.0%
Q2:2010	14,746	2.7%	108.7	1.2%	15,783	2.0%

# Act I: Oil Prices Surge - A Negative SRAS Shock



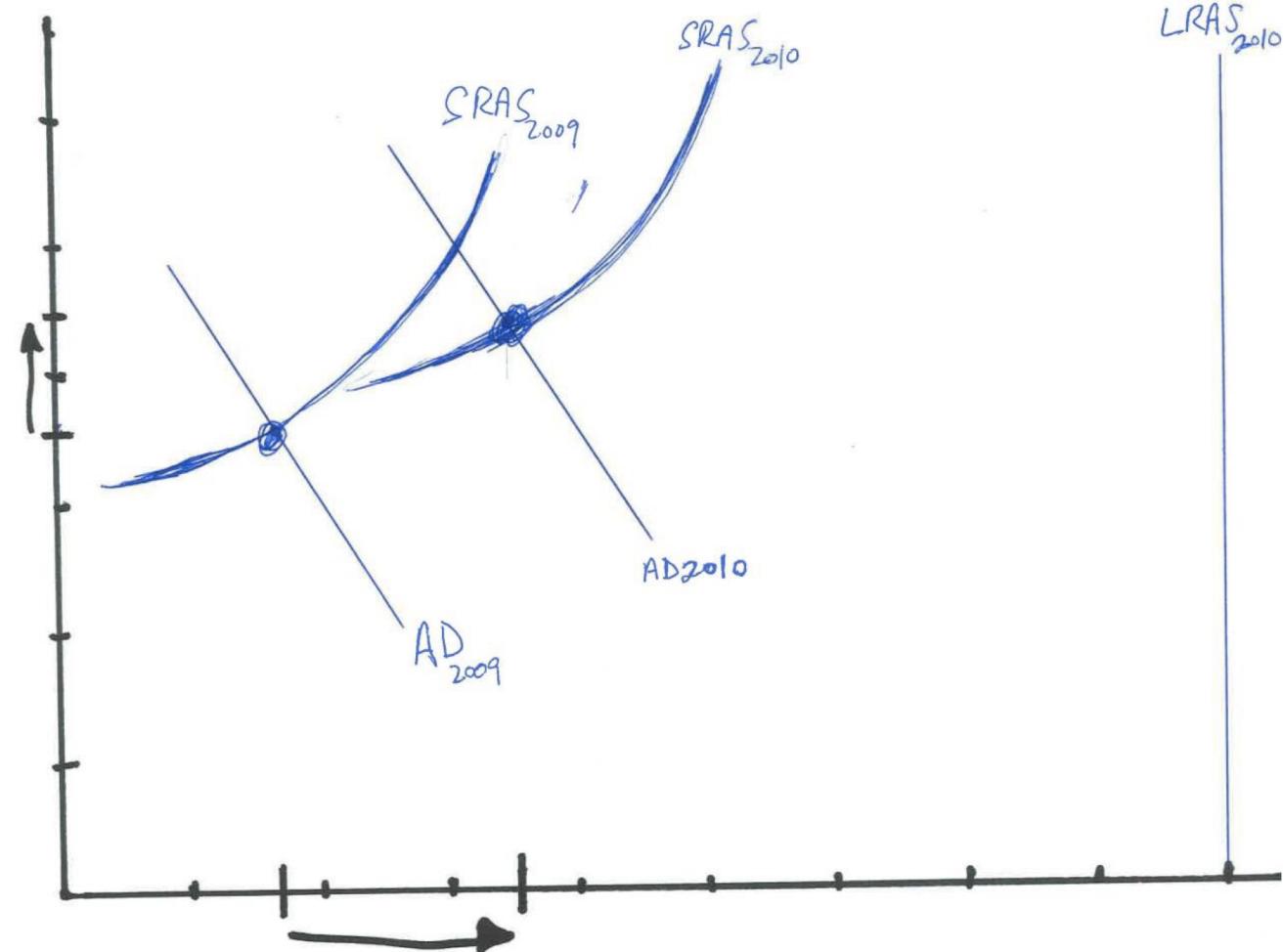
# Act II: A Mild Supply Shock, A Violent Demand Shock

- A **mild supply shock** as productivity is soft
- A **violent demand shock**: Interest rates rise and confidence falls
  - Investment down
  - Consumption plunges, despite falling oil
  - Note: prices rise **less than 2%**, not dynamic equilibrium, as output falls



# Act III: A Positive Supply Shock, A Positive Demand Shock

- A **positive supply shock**:  
Productivity jumps
- A **positive demand shock**:
  - Government stimulus lifts growth
  - Rising confidence lifts C
  - Falling interest rates lift I
  - **NONETHELESS**, inflation rises less than 2%



# Things to Ponder About 2010

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- Why did inflation rise less than 2% despite aggressive government fiscal stimulus?
- Why did risky interest rates fall despite an explosive increase in government borrowing?
- Why did confidence rise despite an explosive rise in the size of the U.S. budget deficit?
- Why SRAS curve was drawn ‘very flat’?
- Despite stimulus, where is GDP vs potential?

# Conclusion 1

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- **Adverse supply shocks** are the **worst** of both worlds:
  - Inflation accelerates **and** output falls
- **Positive supply shocks** are the **best** of all possible worlds:
  - Inflation rates fall **and** real GDP growth accelerates

# Conclusion 2

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- **Adverse demand shocks** have **good and bad** elements:
  - Inflation decelerates as output falls (assuming you are not in or near a deflation)
- **Positive demand shocks** have **good and bad** elements:
  - Inflation rates accelerate as real GDP growth accelerates

# Optimal Macroeconomic Adjustment

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- We want to understand:
  - How employment and inflation **respond** to monetary and fiscal policies
  - How monetary and fiscal policies should be used **in response to shocks**
- **Stabilization policy**: monetary and fiscal policies designed to keep output at (or near) its **full employment** level

# Keynesian Framework

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- How to **reduce imbalances** with two policy instruments: **fiscal policy** and **monetary policy**?

