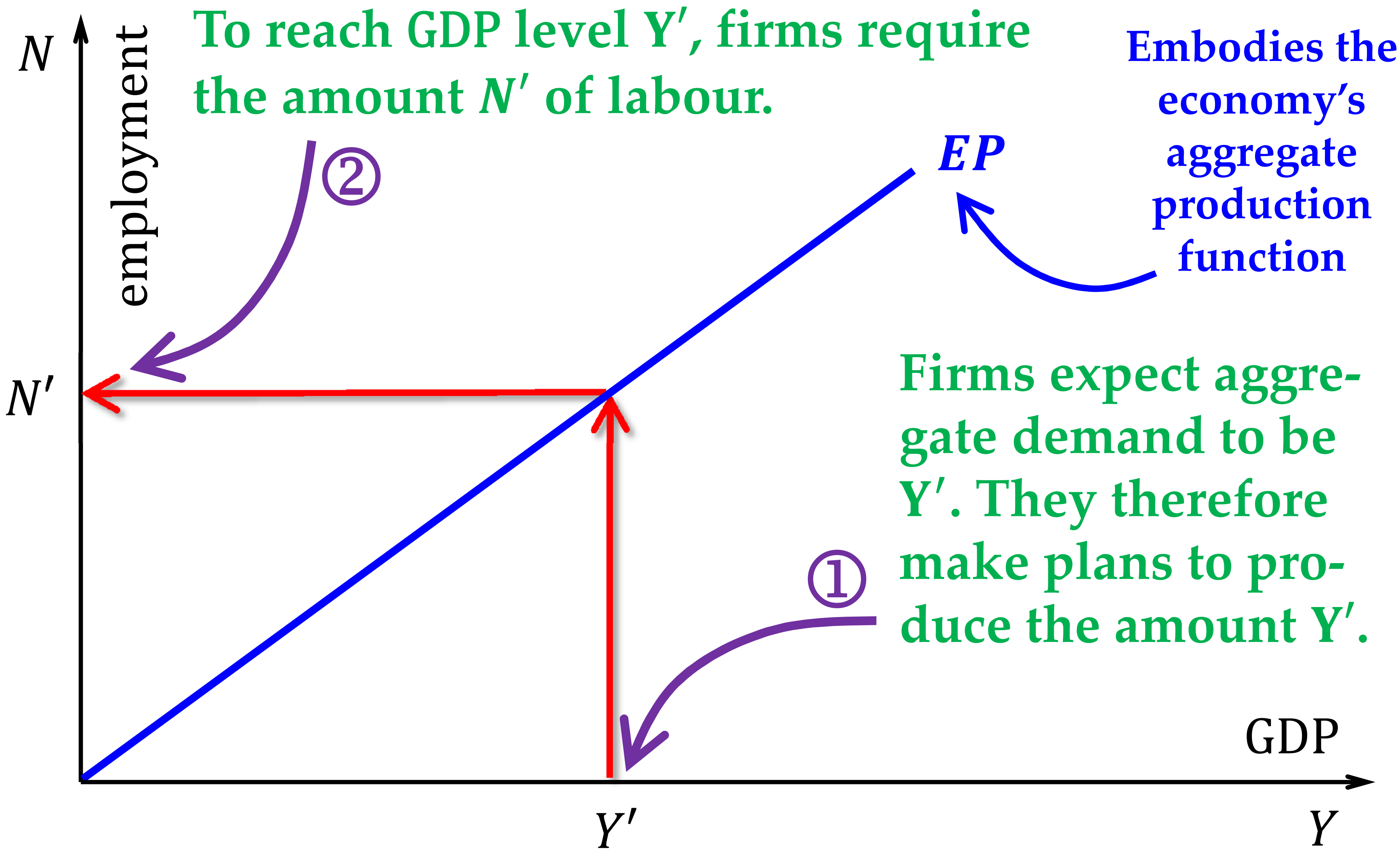
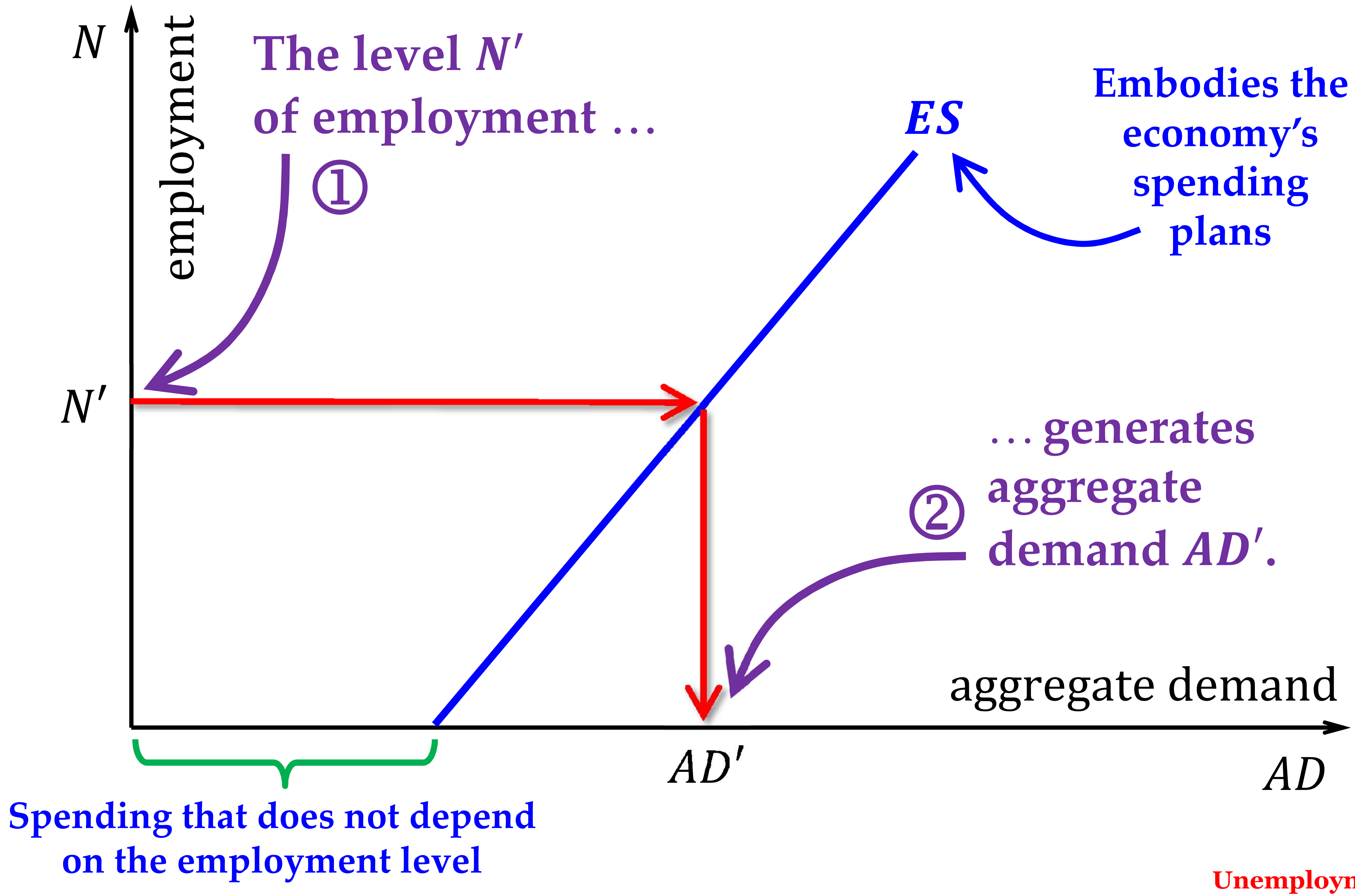
The E-PIS model

- It postulates three linear relations linking employment with production, income, and spending.
  - EP relation (production $\rightarrow$ employment): establishes the amount of employment required to reach a certain GDP level.
  - EI relation (income $\rightarrow$ employment): identifies the amount of labour supplied for every value of aggregate income.
  - ES relation (employment $\rightarrow$ expenditure): indicates the aggregate level of spending associated with any given amount of employment.

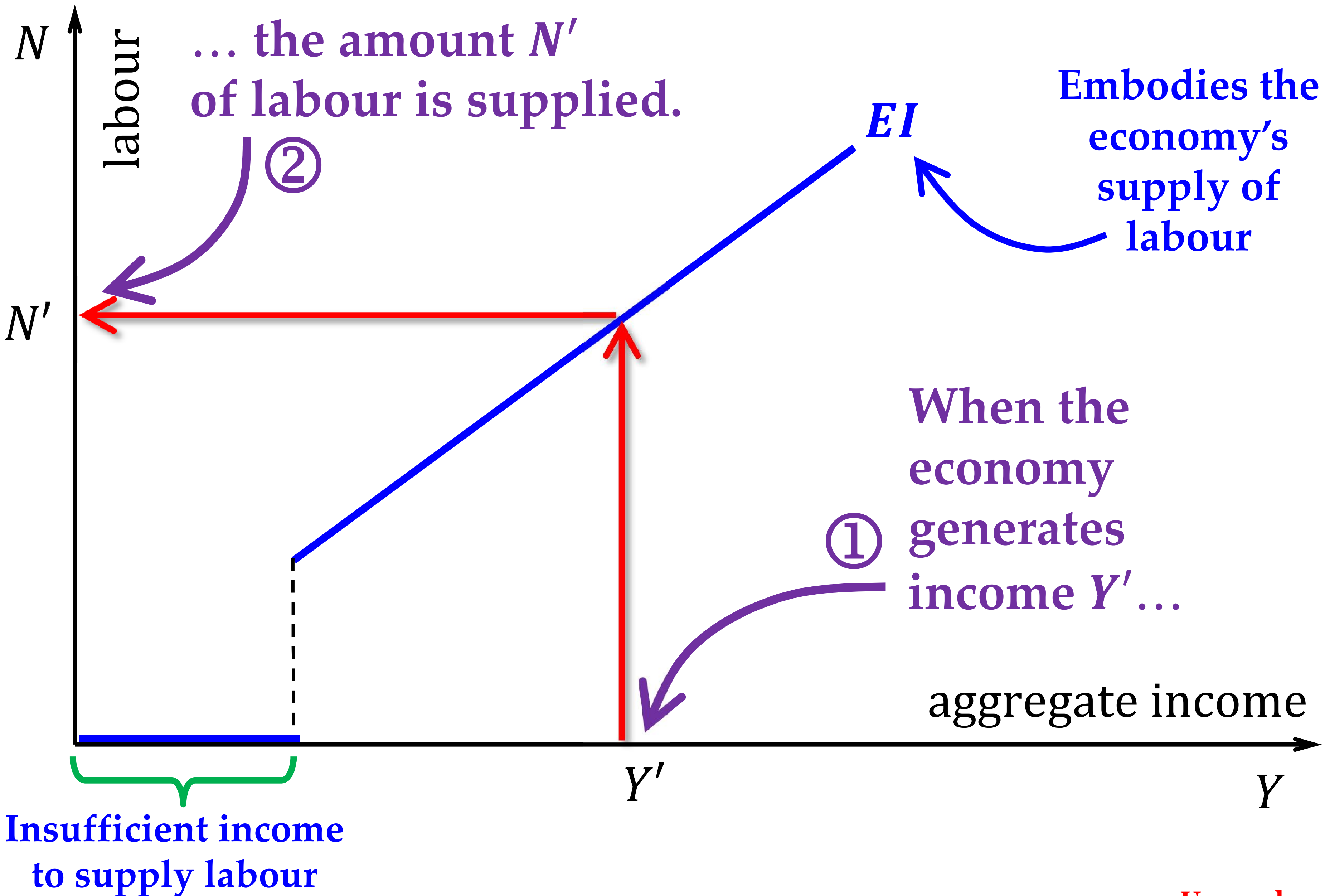
EP (employment-production) relation



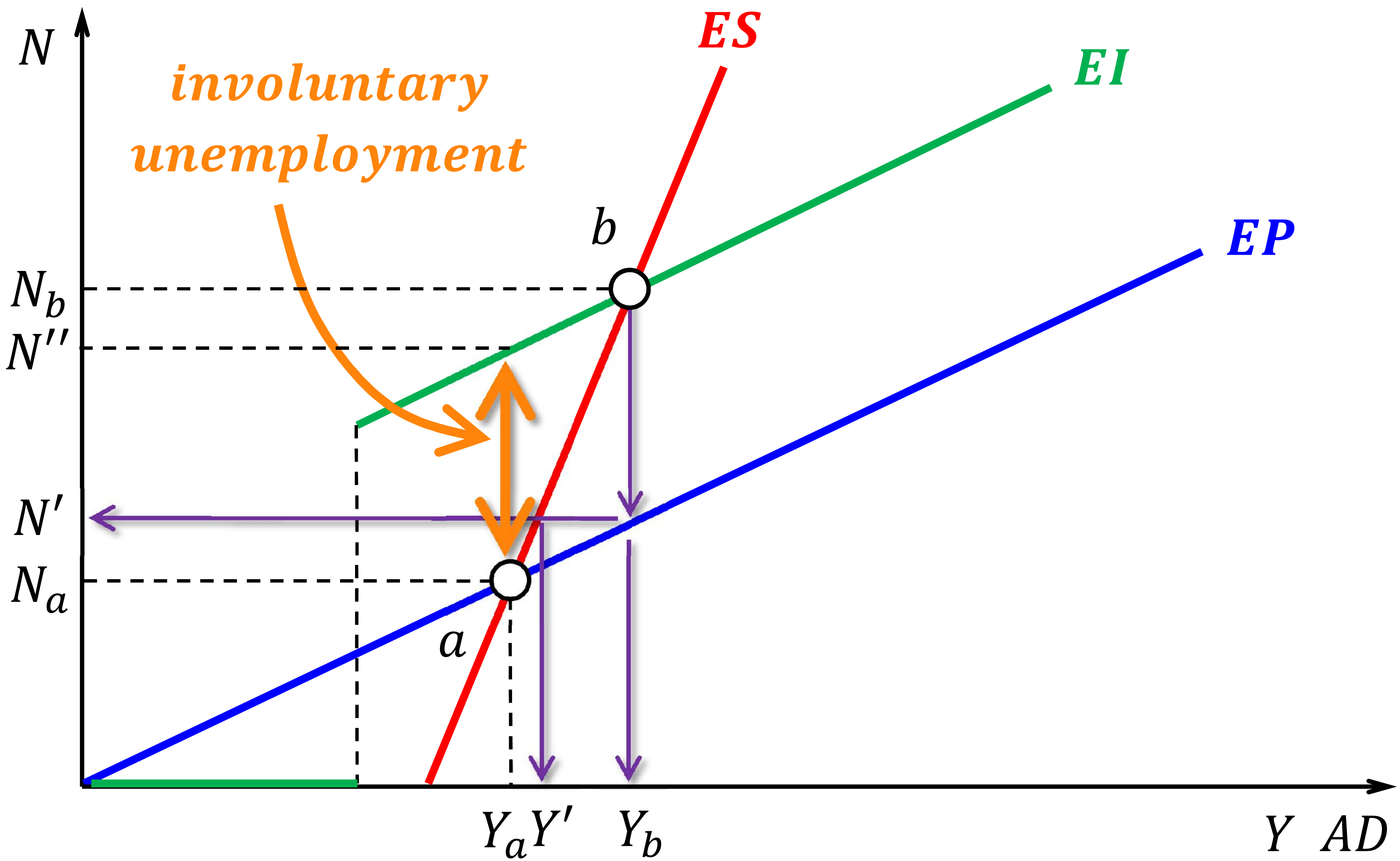
ES (employment-spending) relation



EI (employment-income) relation



Solving the E-PIS model /1



Solving the E-PIS model /2

- When drawn simultaneously, there is no point at which the three relations intersect.

- Without delving into details, let us assume that the solution is found at a point when two lines intersect. Leaving the origin aside, there are two candidates: point a and point b.

- Point b is not stable (self-sustained). At b, employment is N_b and aggregate demand is Y_b. But, according to EP, to produce Y_b, the economy only needs the amount $N' < N_b$ of labour. Hence, b does not represent a consistent state of the economy.

Solving the E-PIS model /3

- At a, employment is N_a and aggregate demand is Y_a. To generate a GDP equal to Y_a firms demand exactly the amount N_a of labour. In addition, the level N_a of employment generates precisely the level Y_a of aggregate demand. This state of the economy appears self-consistent and stable.

- The problem is that there is involuntary unemployment at point a. Given income Y_a, workers would like to supply the amount N'' of labour. Since employment at a is only N_a, $N'' - N_a$ defines the level of involuntary unemployment. Question: what shifts in the lines would reduce it?

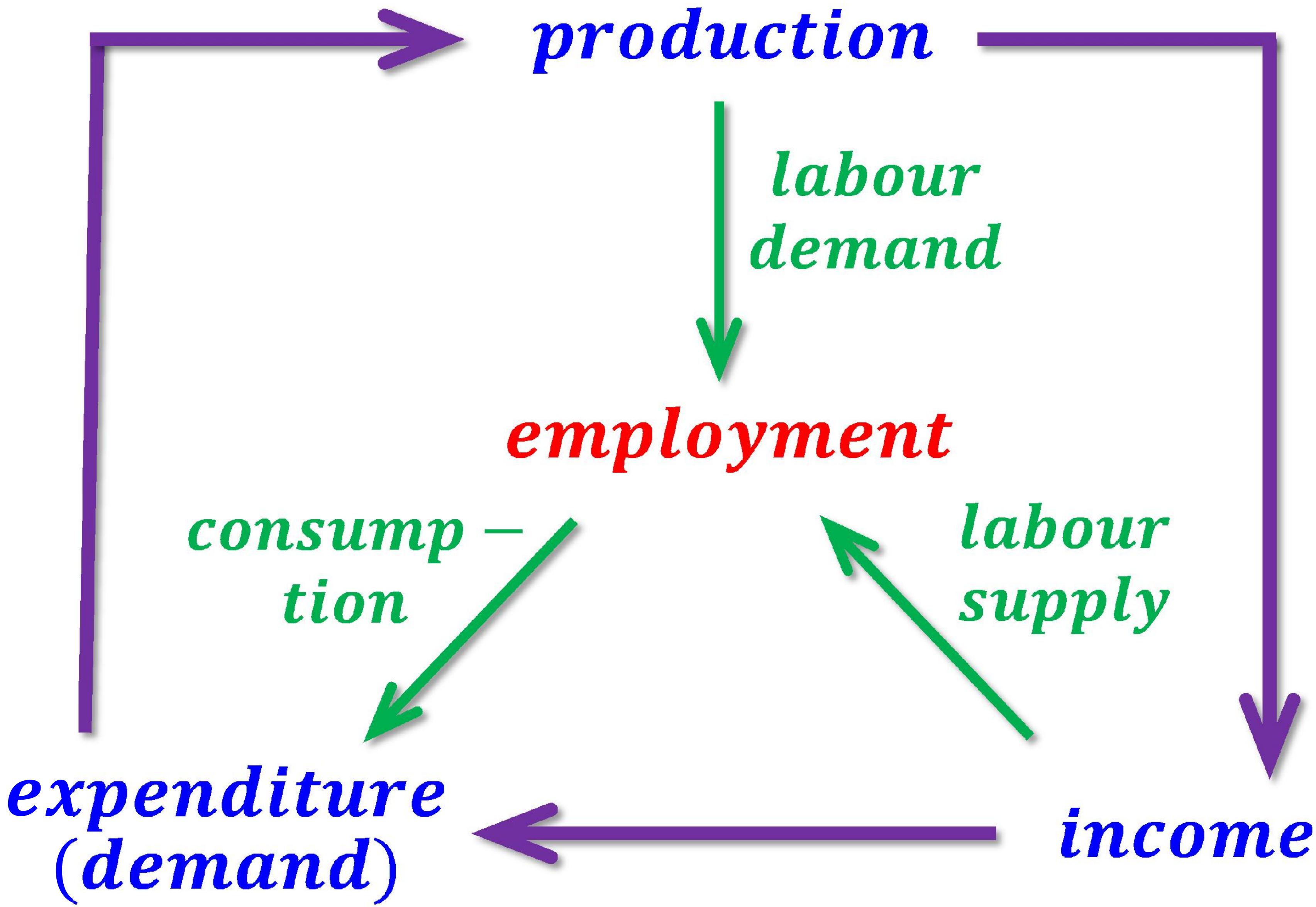
Interpreting the E-PIS model /1

- The arguably simplest description of an economy is given by the loop

production $\rightarrow$ income $\rightarrow$ expenditure $\rightarrow$ production $\rightarrow$ …

- The E-PIS model inserts labour in this loop. First, production creates a derived demand: the demand for labour. Second, the income the economy generates is a key variable helping workers to decide the amount of labour supplied.

- Lastly, the level of employment, once determined, significantly contributes to establish aggregate demand, which in turn affects production.


production
labour demand
employment
consump – tion
labour supply
expenditure (demand)
income

Interpreting the E-PIS model /2

- The <u>classical view</u> of this process attributes to the labour market the leading role. Employment is first established, this next determines production, and production is finally used.

- The <u>Keynesian view</u> inverts the order. First, expenditure decisions are made. These decisions indicate the necessary production level. Finally, the labour required to carry out the production plan is hired.

- The E-PIS model aligns itself with the latter view. The state of the economy is foremost determined by the firms' expected level of aggregate demand.

Interpreting the E-PIS model /3

- To meet the expected demand level Y, firms hire the amount of labour N necessary to produce Y. As long as the income level corresponding to production level Y induces workers to supply <u>at least</u> N, the employment-income relation is irrelevant.

- Since there is no obvious reason why the EI relation cannot be established independently of the other relations, it is highly unlikely that workers will exactly supply N. Thus, the excess of labour supplied constitutes involuntary unemployment. As it emerges from the very working of the economy, it will be hard to eliminate it completely.

The AS-AD model

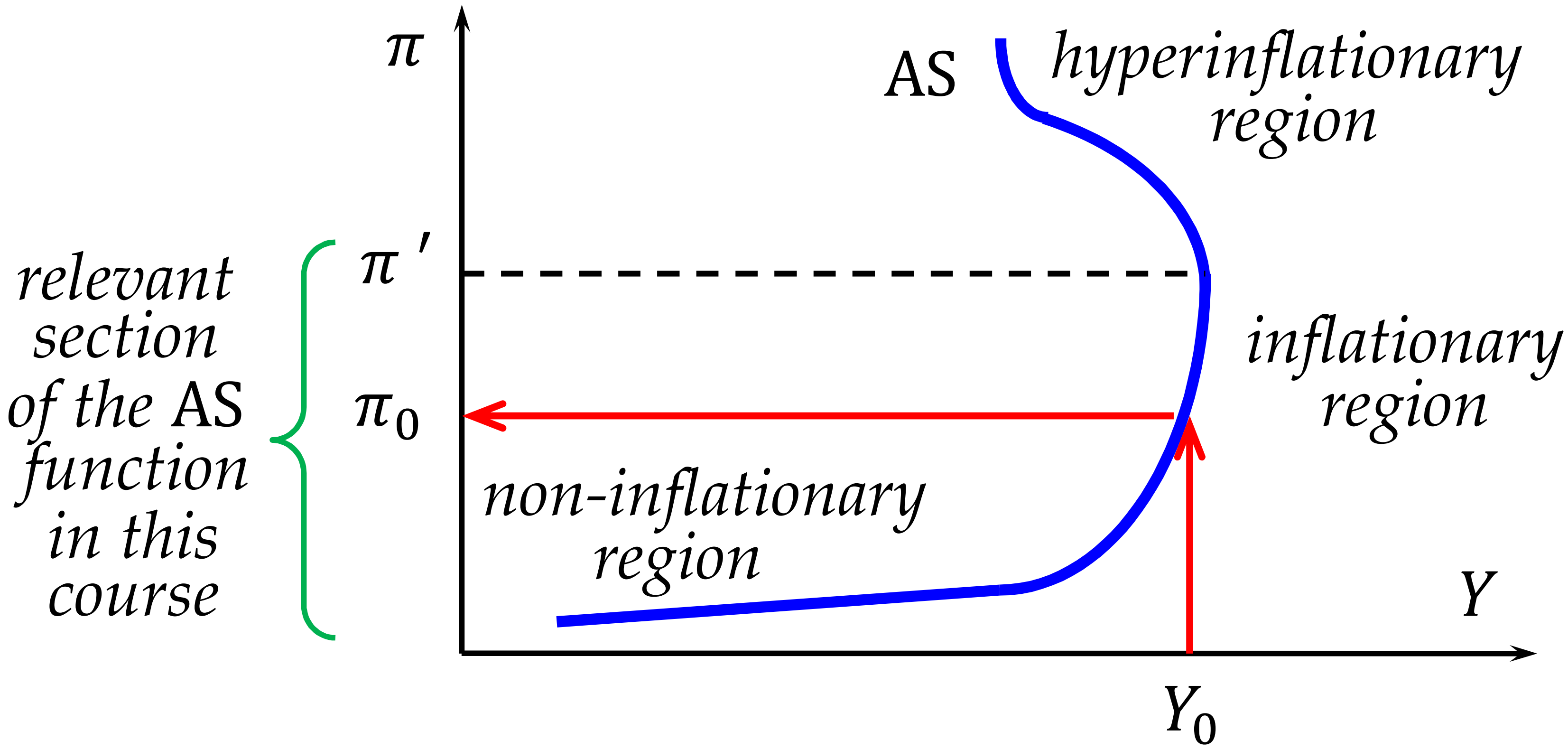
- The aggregate supply-aggregate demand (AS-AD) model is a model built to analyze the fluctuations of both the real GDP Y and the inflation rate π.

- The AS-AD model can be used to provide explanations of the business cycle and to determine the effect of exogenous shocks on the business cycle.

- Loosely speaking, the AS-AD model can be viewed as a macroeconomic version of the competitive market model in which the whole economy is taken to be the market. The model is used to ascertain the impact on Y and π of economic shocks.

Aggregate supply (AS) function

- The AS function establishes, for every amount Y of aggregate production (real GDP), the inflation rate π that results in the economy during the period of time in which Y is produced (when Y_0 is produced, the economy generates inflation rate π_0).



Upward-sloping section

- The AS function is assumed to be upward-sloping up to a certain inflation rate π'. It is for that section that the AS function is read in the direction $Y \to \pi$: <u>production determines inflation</u>.

- The upward-sloping section has two regions. In the <u>non-inflationary region</u> (that may start for negative π), the economy can grow without rising π significantly: there are idle resources usable to increase production without creating a pressure on costs.

- Along the <u>inflationary region</u>, the price to be paid for producing more is having more inflation.

Explaining the inflationary region /1

- Inflation in this region is cost-push inflation.

- Competition for resources. The amount of resources is finite. Hence, as the economy approaches the maximum value of Y that is feasible, firms encounter resource bottlenecks. Eventually, firms can only obtain more inputs by detracting them from other firms. This requires paying more for those inputs to attract them.

- Training costs. More production eventually demands hiring more workers, who in general should be trained to be able to operate efficiently.

Explaining the inflationary region /2

- Reorganization costs. Changing the scale of production may require a production process redesign, which is costly.

- Diminishing marginal productivity. All production process eventually face the law of diminishing marginal productivity: each additional unit of input will in the long run add less to total production. So, to produce the same again, more inputs are needed and costs therefore increase.

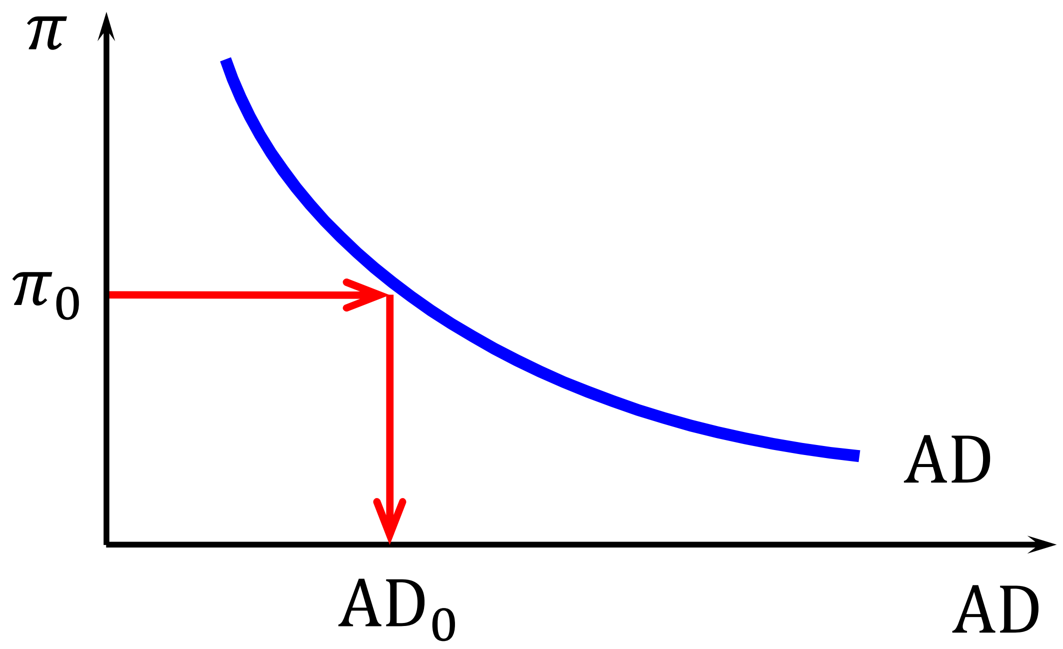
- Example: hours of study is the input to produce knowledge. With all likelihood, the tenth hour does not add as much knowledge as the first one.

Downward-sloping section

- The AS function is assumed downward-sloping above a certain inflation rate π'.
- For a high enough inflation rate (hyperinflation), the production activities no longer run smooth, because, as prices are changing so fast, agents in the economy are more concerned with preserving purchasing power.
- The normal operation of the productive system is disturbed (it is hard to make correct decisions when prices may vary every minute). So it is reasonable to expect a drop in Y when π goes up in an economy suffering from hyperinflation.

Aggregate demand (AD) function

- The AD function establishes, for each inflation rate π, the amount AD of planned aggregate expenditure. AD is the sum of four components: C (aggregate planned consumption) + I (aggregate planned investment) + G (planned government purchases) + NX (aggregate planned net exports).



The AD function is downward-sloping

- Reason 1: as the inflation rate grows, purchasing power diminishes (so consumption tends to be reduced) and competitiveness is eroded (so net exports NX diminish).

- Reason 2: as the inflation rate grows, the CB reacts by rising the interest rate i, which tends to reduce C and I. The increase in i tends to rise the exchange rate e. This rise erodes competitiveness, making net exports NX fall.

- Reason 3: a rise in the inflation rate directly erodes competitiveness, which tends to reduce NX.

The Keynes and Pigou effects

- Keynes effect (starts with the price level P):

$$\downarrow P \;\Rightarrow\; \uparrow\frac{M1}{P} \;\Rightarrow\; \text{excess of money holdings} \;\Rightarrow$$

$$\Rightarrow \uparrow\text{purchases of financial assets} \Rightarrow$$

$$\Rightarrow \uparrow\text{price of financial assets} \Rightarrow \downarrow i \;\Rightarrow \uparrow I \;\Rightarrow \uparrow AD\,.$$

- Pigou (real balance) effect:

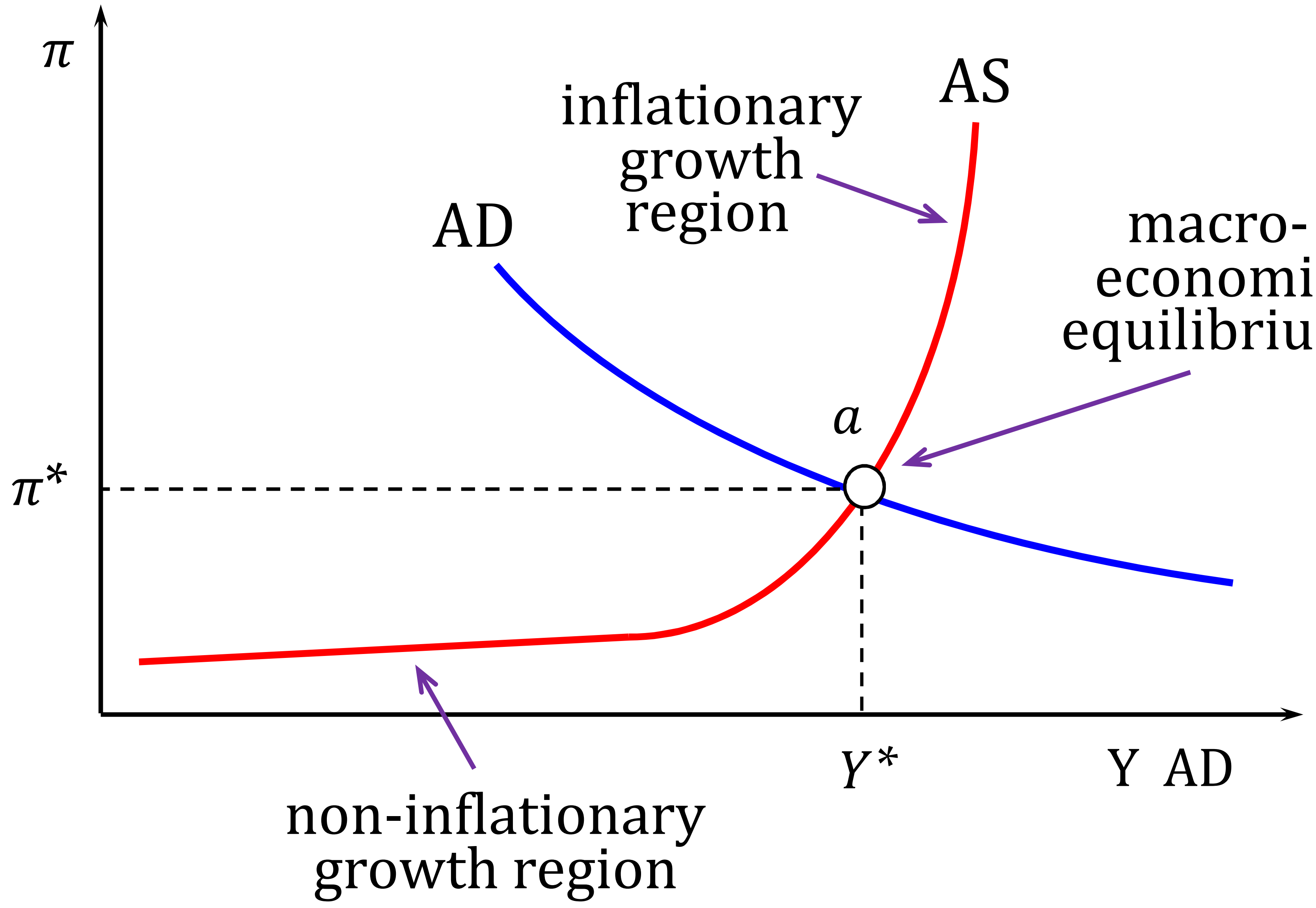
$$\downarrow P \;\Rightarrow\; \uparrow\text{wealth in real terms} \Rightarrow \uparrow C \uparrow I \Rightarrow \uparrow AD\,.$$

- Reply by M. Kalecki: $\downarrow$P $\Rightarrow$ $\uparrow$real value of debt $\Rightarrow$ $\uparrow$bankruptcies (confidence crisis). As Japan in the 1990s illustrates, $\downarrow$P may imply $\downarrow$C because spending is delayed expecting a future fall in P.

Macroeconomic equilibrium

- The macroeconomic equilibrium condition states that $Y = AD$: aggregate production equals planned aggregate expenditure.
- Any pair (Y^*, π^*) satisfying the macroeconomic equilibrium condition is a macroeconomic equilibrium. Whereas Y^* is the equilibrium production (equilibrium income or equilibrium expenditure), π^* is the equilibrium inflation rate.
- Geometrically, a macroeconomic equilibrium is represented by the intersection of the AS function and the AD function.

Macroeconomic equilibrium displayed



Changes in macro equilibrium

- <u>Not everything is constant along the AS function</u>: wages, for instance, may change. That change is endogenous in the sense that it is generated by the production sector itself.

- <u>Not everything is constant along the AD function</u>: the i and e, for instance, may change (the change of i is the result of a built-in feature of the model: the automatic response of the CB to rising inflation).

- Since it may not be obvious what can change or not along these functions, it is convenient to list factors that naturally shift them.

Negative shocks to the AS function

- The AS function is expected to shift left when
  - production costs exogenously rise (for instance, an oil shock for an oil importing economy or the government declares a wage increase);
  - the amount of resources (factors of production) falls;
  - less credit is available;
  - the number of firms is reduced;
  - the government rises taxes;
  - the inflation rate is expected to rise the next period (likely effect);
  - more pessimistic expectations of businessmen on the evolution of the economy.

Positive shocks to the AS function

- The AS function is expected to shift right when
  - production costs exogenously fall;
  - the amount of resources increases;
  - more credit is available;
  - the number of firms rises;
  - the government lowers taxes;
  - previous investments become operative;
  - technological progress applied to production;
  - improvements in the organization of production;
  - productivity increases;
  - businessmen adopt optimistic (profit) expectations.

Positive shocks to consumption

- Aggregate planned consumption C (and, therefore, AD) is <u>positively affected</u> by
  - increases in income and wealth (for instance, a rise in the price of shares);
  - an increase in the number of consumers (more population);
  - the expectation that income, wealth, the inflation rate, or the interest rate will grow in the future (better to consume now than later);
  - a reduction of taxation/a rise in transfers;
  - the reduction in the (real) interest rate;
  - credit made more easily available.

Positive shocks to investment

- Aggregate planned investment I (and, therefore, AD) is positively affected by
  - favourable expectations by businessmen (on profits, the evolution of the economy);
  - an increase in the number of firms;
  - subsidies stimulating investment;
  - a reduction of taxes on profits;
  - the reduction in the (real) interest rate;
  - credit made more easily available;
  - technological progress.

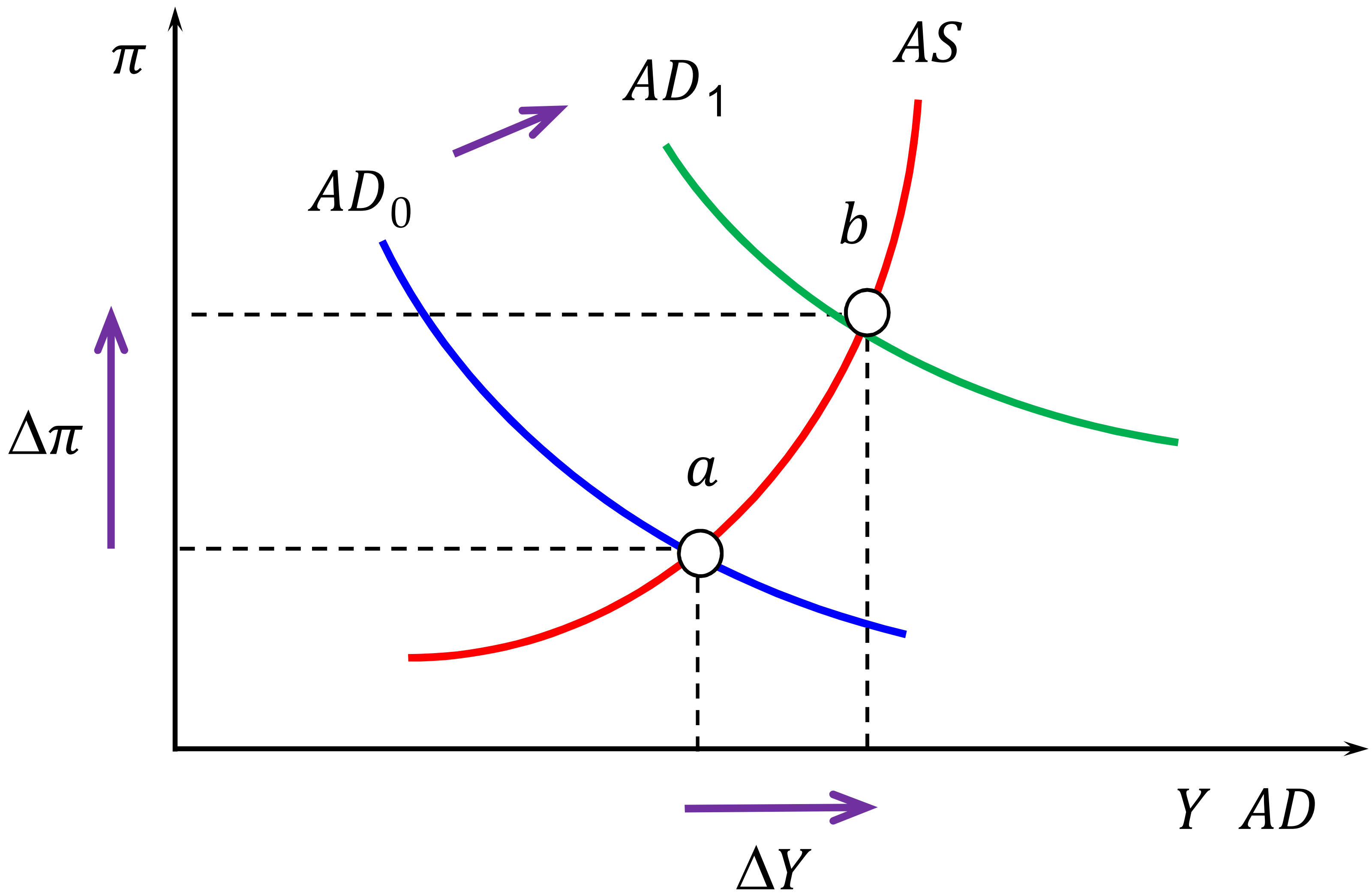
Positive shocks to net exports

- Aggregate planned net exports NX (and, therefore, AD) is <u>positively affected</u> by
  - a reduction in domestic income (less imports);
  - an increase in foreign income (more exports);
  - a depreciation of the nominal exchange rate (domestic goods become cheaper);
  - a reduction in domestic inflation in comparison to the rest of the world (competiteveness is gained);
  - an increase in foreign inflation in comparison to domestic inflation;
  - government subsidies to exports;
  - a rise in tariffs.

Effects of an AD expansion

- The next slide shows the effect of an AD expansion: the equilibrium inflation rate and production both rise (an AD contraction causes the opposite result).
- This general conclusion should be qualified: if the economy lies in the non-inflationary region, the increase in the inflation rate may be negligible (and the AD expansion only creates GDP growth).
- If the economy lies ahead in the inflationary region (and near the largest feasible amount of production), it is the increase in production that may be negligible (so the AD expansion only creates inflation).

Positive demand shock: primary effects



Multiplier effect /1

***AD* function** $AD = C + I = (4 + 0.8 \cdot Y - \pi) + 10 =$

$$= 14 + 0.8 \cdot Y - \pi$$

***AS* function** $Y = 30 \cdot \pi$

Macroeconomic equilibrium condition $Y = AD$

- In equilibrium, $Y = 4 + 0.8 \cdot Y - \pi$, with $Y = 30 \cdot \pi$. Hence, $0.2 \cdot Y = 14 - \pi$. Amb $Y = 30 \cdot \pi$, $0.2 \cdot 30 \cdot \pi = 14 - \pi$. That is, $6 \cdot \pi = 14 - \pi$, so $\pi^* = 2$ is the equilibrium inflation rate. Given $\pi^* = 2$, the AS function yields the equilibrium production level $Y^* = 30 \cdot 2 = 60$.

Multiplier effect /2

- The impact on Y^* of a change in the AD function is the result of an <u>expenditure multiplier effect</u>.
- Since expenditure AD depends on income Y and, in equilibrium $Y = AD$, the sequence

$$\Delta AD \rightarrow \Delta Y \rightarrow \Delta AD \rightarrow \Delta Y \rightarrow \dots$$

  is generated, so a change in AD multiplies itself.
- <u>Example</u>. Let the AD function only depend on C and I, so $AD = C + I$. Let I be constant. Specifically, $C = 4 + 0.8Y - \pi$ and $I = 10$ (the 0.8 is the <u>marginal propensity c to consume</u>: which fraction of an additional unit of income is consumed).

Multiplier effect /3

- The AS function is $Y = 30 \cdot \pi$. The macroeconomic equilibrium is obtained from the condition $Y = AD$. That is, $Y = 4 + 0.8 \cdot Y - \pi + 10$. Thus, $0.2 \cdot Y = 14 - \pi$. As $Y = 30 \cdot \pi$, $\pi = 2$ (π is a percentage).
- Imagine now that there is an increase in investment, from 10 to 17 (for instance, businessmen become more optimistic).
- To better illustrate the multiplier effect, assume that the inflation rate does not change and remains at 2% (it is as if the AS function were horizontal at $\pi = 2$: the economy absorbs any increase in planned expenditure without fuelling inflation).

Multiplier effect /4

- The state of the economy is described by equations $Y = AD$ and $\pi = 2$. Hence, $Y = 4 + 0.8 \cdot Y - \pi + 17 = 19 + 0.8Y$. That is, $0.2Y = 19$, so $Y = 95$.
- To sum up, expenditure has only been increased 7 units (from $I = 10$ to $I = 17$), but production and income have risen 35 units (from $Y = 60$ to $Y = 95$). This is caused by the multiplier effect. In this case, the multiplier is 5, which equals $1/(1 - c)$.
- When the AS function enters the picture, part of the expenditure is transformed into inflation. With $Y = 30 \cdot \pi$ and $AD = 4 + 0.8 \cdot Y - \pi + 17$, $\pi^* = 3$ and $Y^* = 90$ (inflation eats up 5 units of income).

Temporary shock

temporary shock on I

$\pi = 2$

time	Y	$C = 4 + 0.8 \cdot Y - \pi$	I	$AD = C + I$
0	60	$4 + 0.8 \cdot 60 - 2 = 50$	10	60
1	60	$4 + 0.8 \cdot 60 - 2 = 50$	17	$50 + 17 = 67$
2	67	$4 + 0.8 \cdot 67 - 2 = 55.6$	10	$55.6 + 10 = 65.6$
3	65.6	$4 + 0.8 \cdot 65.6 - 2 = 54.48$	10	$54.48 + 10 = 64.48$
4	64.48	$4 + 0.8 \cdot 64.48 - 2 = 53.58$	10	$53.584 + 10 = 63.58$
5	63.58	$4 + 0.8 \cdot 63.58 - 2 = 52.86$	10	$52.86 + 10 = 62.86$
...	...	...	10	...
∞	60	$4 + 0.8 \cdot 95 - 2 = 78$	10	$50 + 10 = 60$

$\Delta Y_2 = 7$

$\Delta Y_3 = 1.4$

$\Delta Y_4 = 1.12$

$\Delta Y_5 = 0.896$

equilibrium

Permanent shock

permanent shock on I

$\pi = 2$

multiplier effect

time	Y	$C = 4 + 0.8 \cdot Y - \pi$	I	$AD = C + I$
0	60	$4 + 0.8 \cdot 60 - 2 = 50$	10	60
1	60	$4 + 0.8 \cdot 60 - 2 = 50$	17	$50 + 17 = 67$
2	67	$4 + 0.8 \cdot 67 - 2 = 55.6$	17	$55.6 + 17 = 72.6$
3	72.6	$4 + 0.8 \cdot 72.6 - 2 = 60.08$	17	$60.08 + 17 = 77.08$
4	77.08	$4 + 0.8 \cdot 77.08 - 2 = 63.66$	17	$63.66 + 17 = 80.66$
5	80.66	$4 + 0.8 \cdot 80.66 - 2 = 66.53$	17	$66.53 + 17 = 83.53$
...	...	...	17	...
∞	95	$4 + 0.8 \cdot 95 - 2 = 78$	17	$78 + 17 = 95$

$\Delta Y_2 = 7$

$\Delta Y_3 = 5.6$

$\Delta Y_4 = 4.48$

$\Delta Y_5 = 3.58$

equilibrium

Shock with inflation adjustement

multiplier effect

time	Y	$C = 4 + 0.8 \cdot Y - \pi$	I	$AD = C + I$	$\pi = \frac{Y}{30}$
0	60	$4 + 0.8 \cdot 60 - 2 = 50$	10	60	2
1	60	$4 + 0.8 \cdot 60 - 2 = 50$	17	$50 + 17 = 67$	2.23
	$\Delta Y_2 = 7$				
2	67	$4 + 0.8 \cdot 67 - 2.23 = 55.37$	17	$55.37 + 17 = 72.37$	2.41
	$\Delta Y_3 = 5.37$				
3	72.37	$4 + 0.8 \cdot 72.37 - 2.41 = 59.48$	17	$59.48 + 17 = 76.48$	2.54
	$\Delta Y_4 = 4.11$				
4	76.48	$4 + 0.8 \cdot 76.48 - 2.54 = 62.64$	17	$62.64 + 17 = 79.64$	2.65
	$\Delta Y_5 = 3.16$				
5	79.64	$4 + 0.8 \cdot 79.64 - 2.65 = 65.06$	17	$65.06 + 17 = 82.06$	2.73
...	...	...	17	...	...
∞	90	$4 + 0.8 \cdot 90 - 3 = 73$	17	$73 + 17 = 90$	3

equilibrium

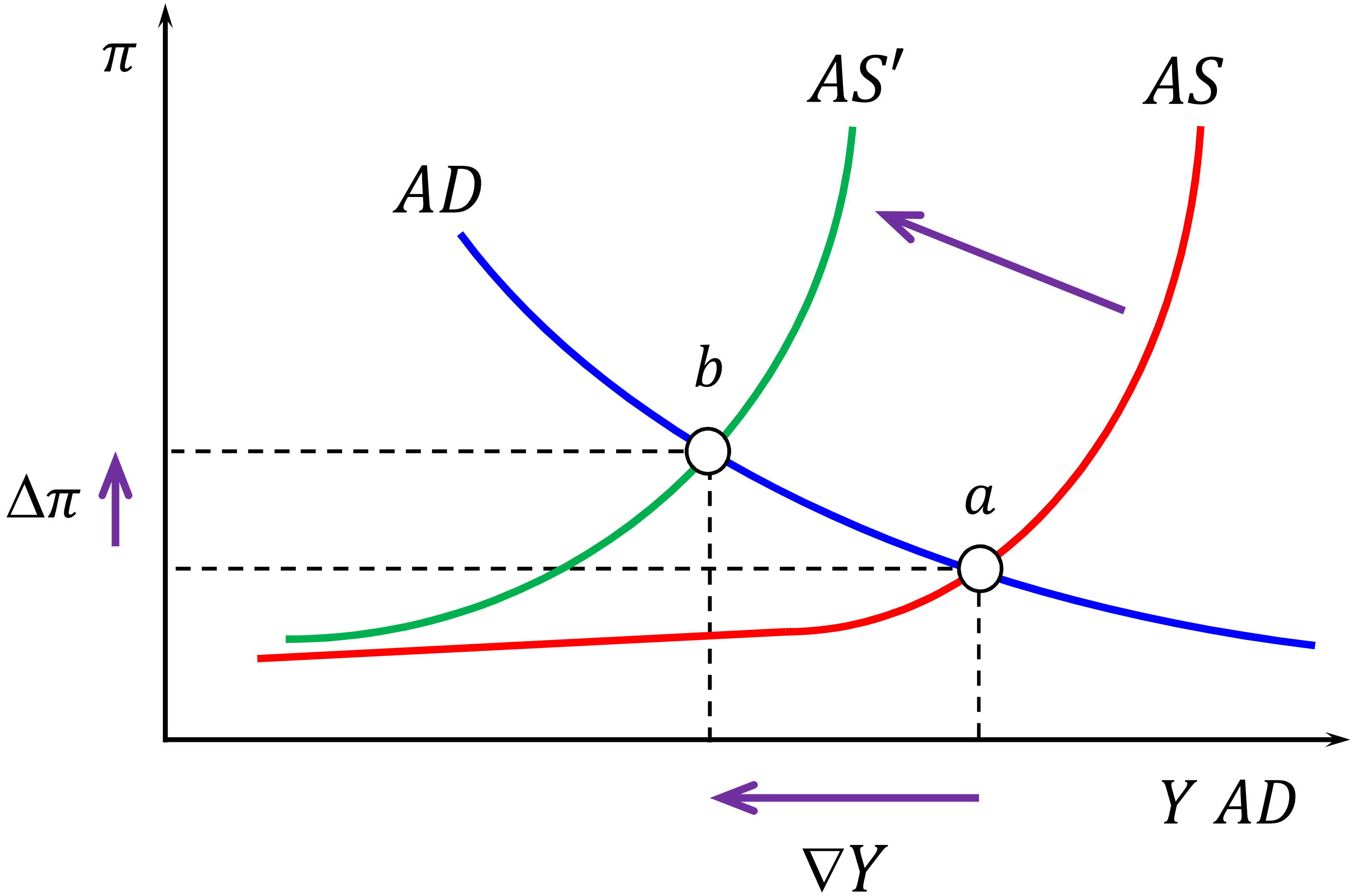
Effects of an AS contraction

- The next slide shows the effect of an AS contraction: the equilibrium inflation rate rises but production falls.

- This phenomenon is called stagflation: stagnant economy with rising inflation. Western economies all experienced staglation in the 1970s.

- An AS expansion causes the opposite result: non-inflationary growth. The US economy experienced this result in the 1990s (it was then speculated that a *New Economy* was born capable of sustaining non-inflationary growth thanks to continuous producti-vity gains created by the digital revolution).

Negative supply shock: primary effects



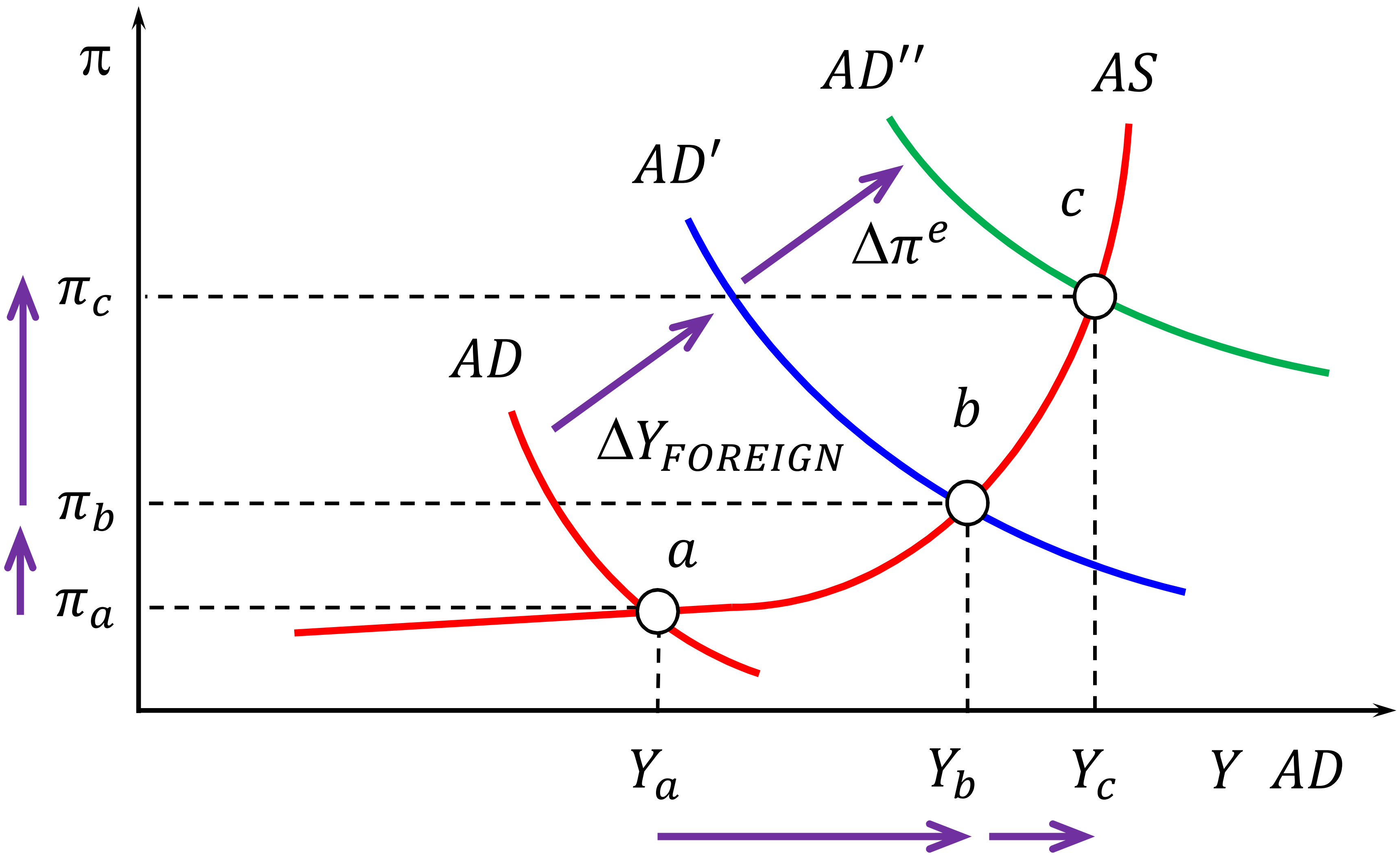
Secondary effects of shocks

- The effects of a shock need not be limited to the primary effects, because the new macroeconomic equilibrium need not be stable. Consequently, <u>the initial shock may induce more shocks</u>.

- The additional changes in the macro equilibrium are typically generated by changes in the expected inflation rate (π^e) caused by the initial shock.

- Suppose, for instance, that foreign outcome raises. This causes a positive demand shock (ΔNX) that shifts right the AD function; see the next slide.

Role of inflationary expectations



Self-replicating shocks

- Suppose AD is drawn assuming a correct expected inflation rate: $\pi^e = \pi_a$. After the shock, the inflation rate rises to π_b, so people realize that their expectation is incorrect: inflation is higher than expected.

- It is reasonable to presume that people will rise π^e. This shifts the AD function from AD' to AD'', which stimulates the economy further.

- If π^e in AD'' is smaller than the new equilibrium inflation rate π_c, inflationary expectations will continue to grow. Curiously, <u>it is the expectation of a higher inflation that generates a higher inflation</u>.

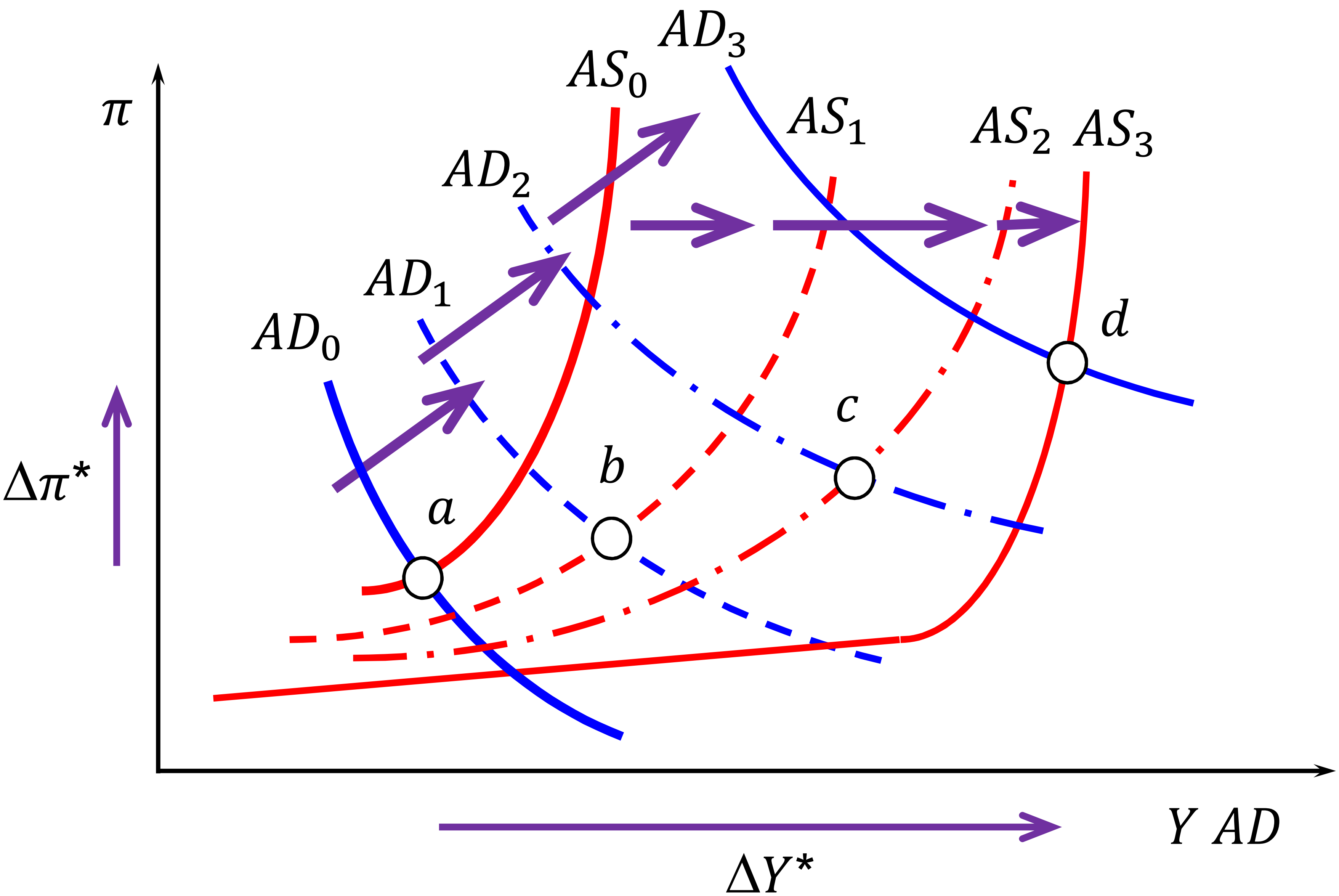
Business cycle in the AS-AD model

- That same logic explains the sustainability of the expansion period of the business cycle (and also the sustainability of the recession period).

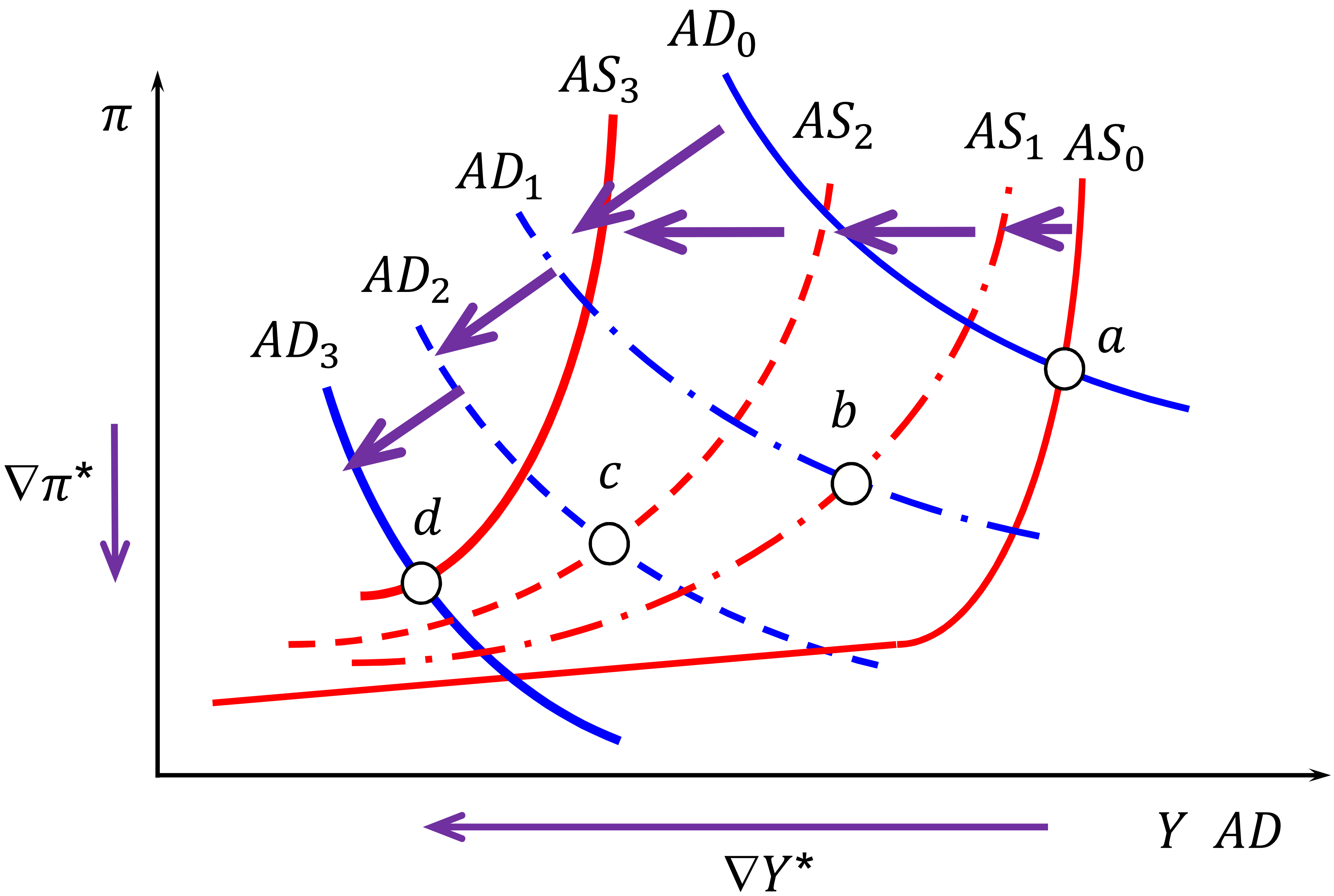
- The next two slides (47 and 48) illustrate how the expansion and recession periods arise: a continuous shift in, typically, both functions.

- The third slide (49) depicts the typical evolution of production and the inflation rate during the business cycle. The fourth slide (50) shows how this pattern can be generated by a simple example.

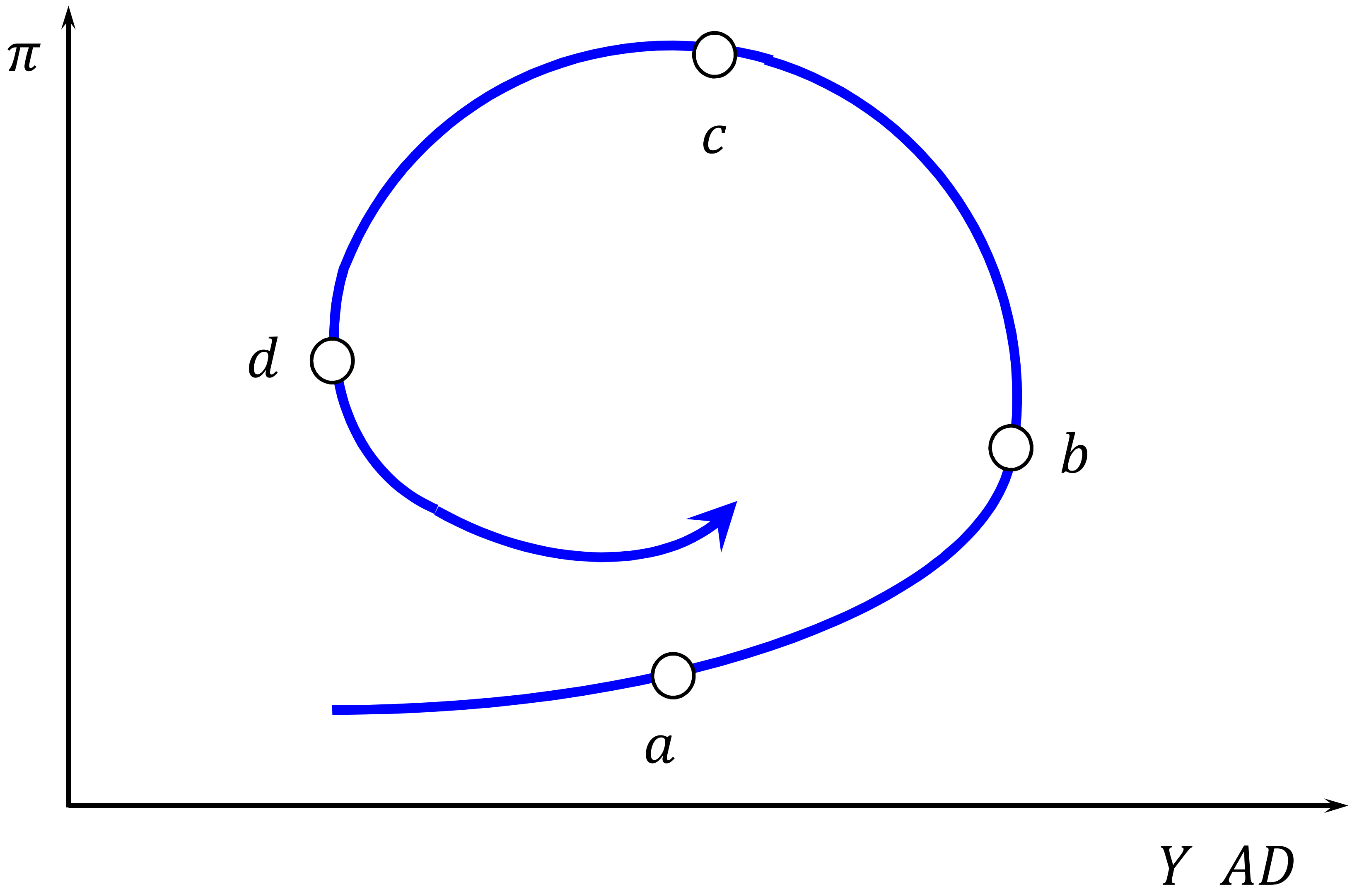
A booming economy



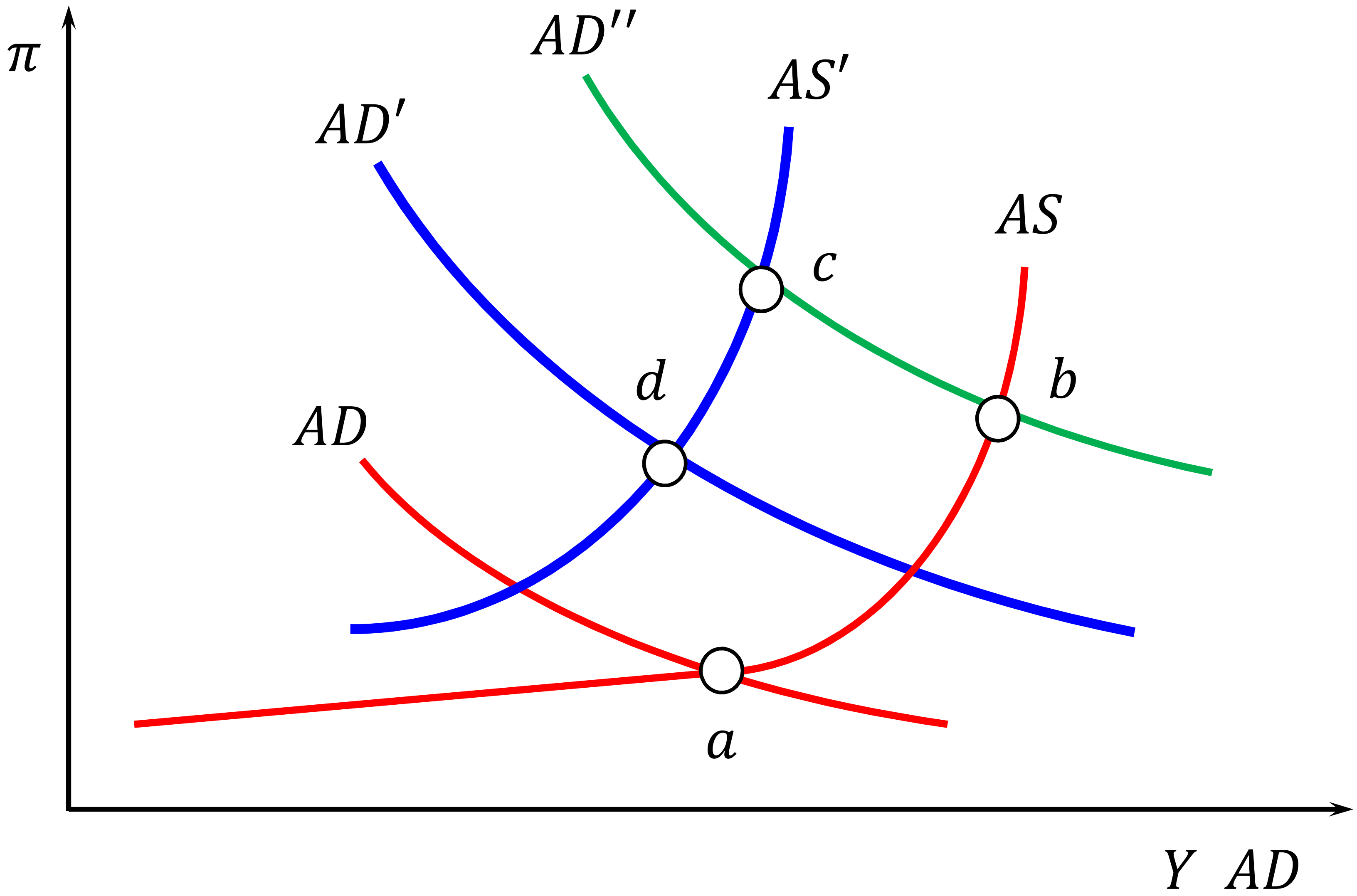
A slumping economy



Typical business cycle loop



Business cycle example



Creating business cycles: an example

- The initial point is a. The collective agreement of wages is being negotiated and workers expect a certain increase in wages. At the expense of the future wage increase, workers raise consumption now. AD shifts to the right and b is reached.

- By then the agreement terms are known: there is a surge in wages but less than expected. That increase shifts AS to the left. The equilibrium goes from b to c. But since the wage rise was smaller than expected, workers cut consumption (AD' moves to AD'') and d is reached.

Long-run & short-run macroeconomics

- Textbooks make production converge to a long run fixed production level representing potential GDP, which is presumed to be given and unaffected by short run decisions. This is a quite debatable assumption (in fact, there does not appear to be a long run but a sequence of short runs).

- "The long run is a misleading guide to current affairs. In the long run we are all dead. Economists set themselves too easy, too useless a task if in tempestuous seasons they can only tell us that when the storm is past the ocean is flat again." J. M. Keynes, *A Tract on Monetary Reform*, 1923, Ch. 3.