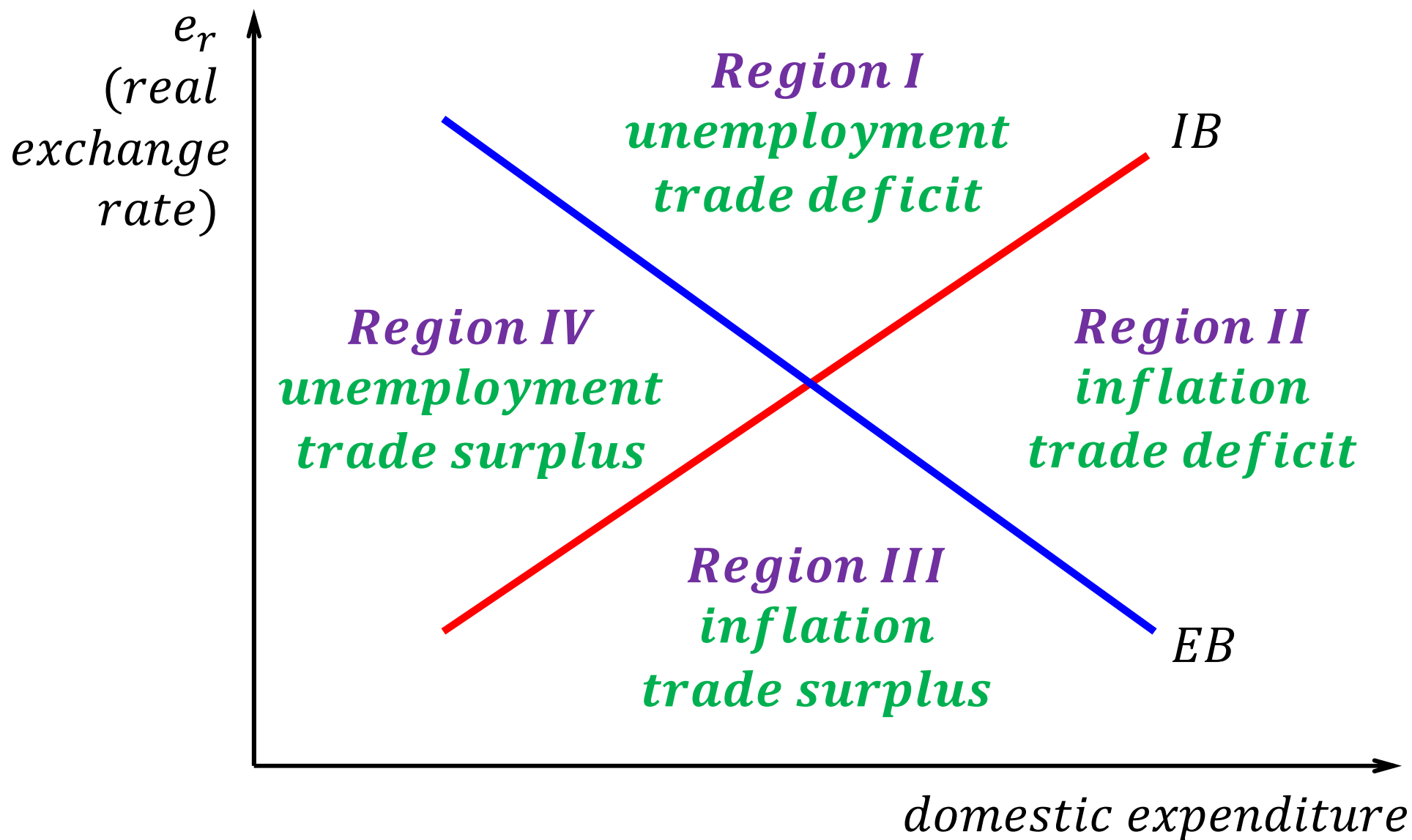# The Swan diagram

Internal and external balance

- Internal balance requires full employment of resources (sufficiently low unemployment rate) and price stability (low and stable inflation rate).

- External balance corresponds to a balanced current account (the supply and demand for the domestic currency are balanced). For simplicity, external balance is defined as zero trade balance.

- Internal balance and external balance both are assumed to depend on two variables: domestic expenditures and the real exchange rate.

The internal balance (IB) function /1

- The <u>IB function</u> drawn on the next slide is assumed <u>increasing</u> for the following reason.

- Suppose the economy is initially at point a. If a real appreciation occurs (the real exchange rage increases), then imports rise and exports fall. That is, there is a switch in demand from domestic to foreign goods. As a result, unemployment goes up and the economy moves from point a to b.

- To restore internal balance by reaching point c, unemployment must be eliminated. This requires an increase in domestic expenditure.

Interpreting the IB function /1
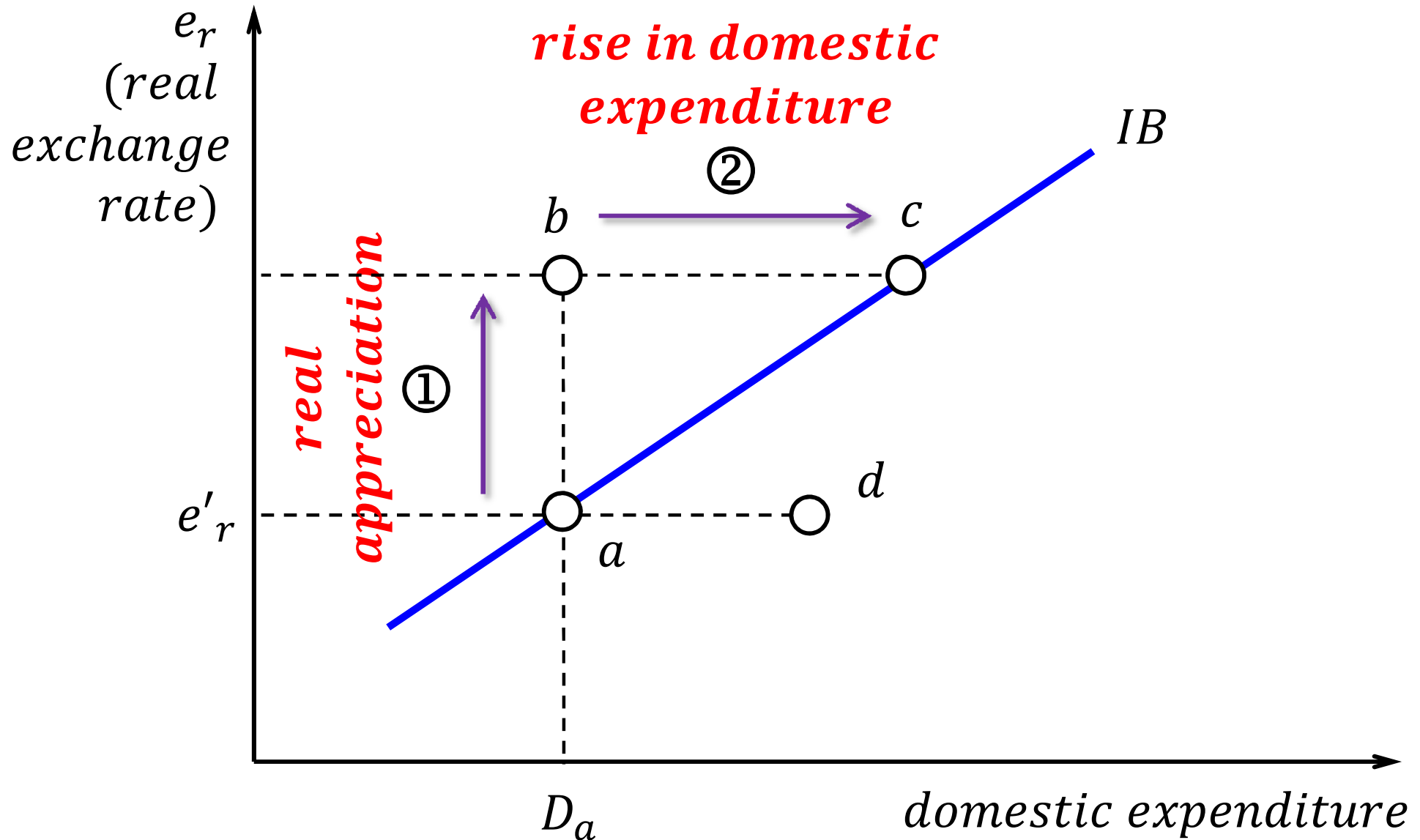
The internal balance (IB) function /2

- If follows from the previous analysis that <u>points above the IB function</u> (excessive expenditure abroad) <u>imply the existence of unemployment</u>.

- Below the IB function failure of internal balance is not due to unemployment but to <u>inflation</u>.

- For instance, at point d, given the corresponding real exchange rate e'_r, domestic expenditure is excessive with respect to the level D_a required to reach internal balance. This excess of domestic expenditure manifests itself in the form of inflation.

Interpreting the IB function /2

e_r
(real exchange rate)

unemployment

inflation

IB

domestic expenditure
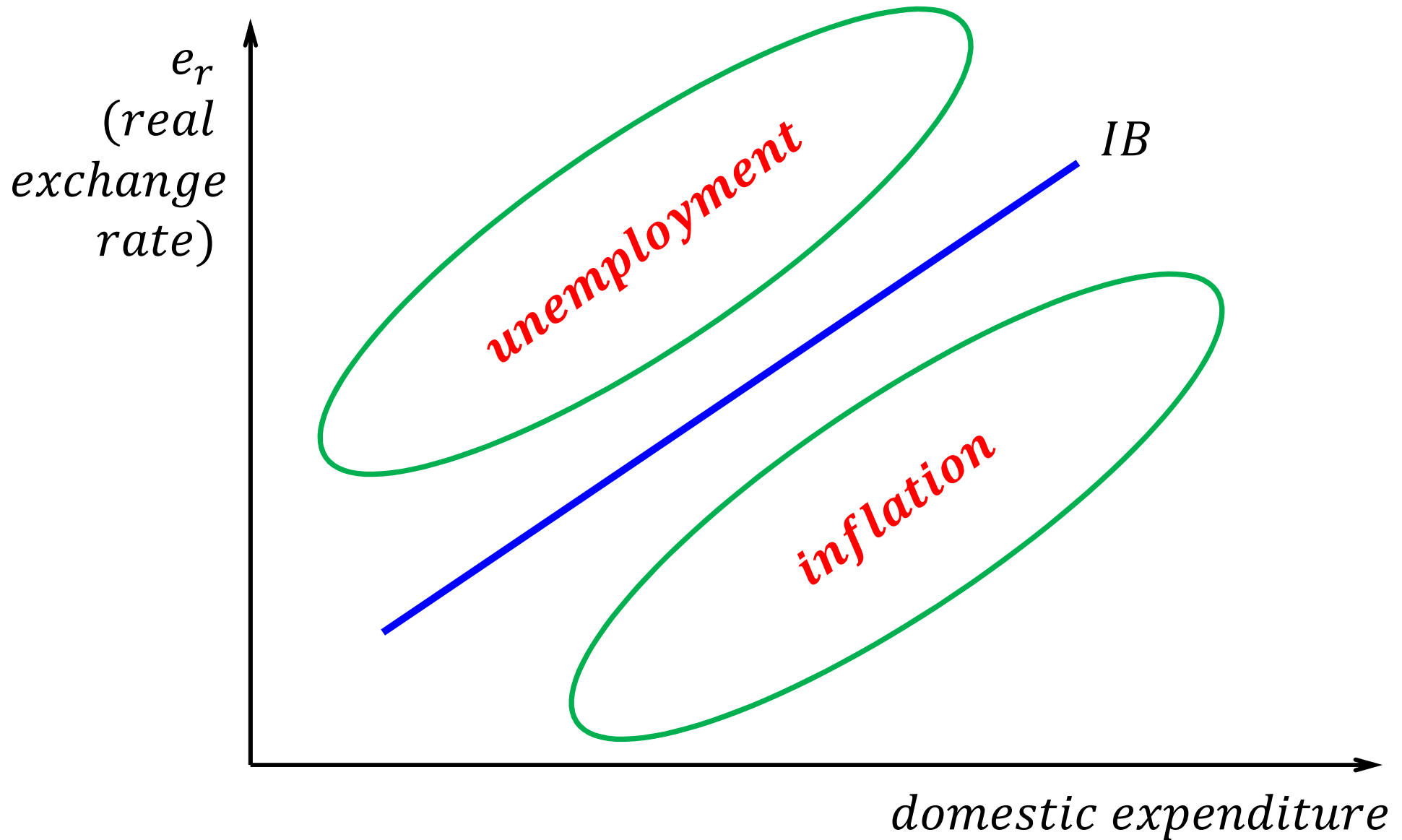
The external balance (EB) function /1

- The <u>EB function</u> drawn on the next slide is assumed <u>decreasing</u> for the following reason.

- Suppose the economy is initially at point *a*, where the trade balance is zero. If domestic expenditure increases, GDP and, consequently, income also increase. Part of this additional income is spent buying foreign goods. A trade deficit ensues.

- To restore external balance by reaching point *c*, the trade deficit must be neutralized. This requires a reduction in the real exchange rate: a real depreciation (an improvement of competitiveness).

Interpreting the EB function /1
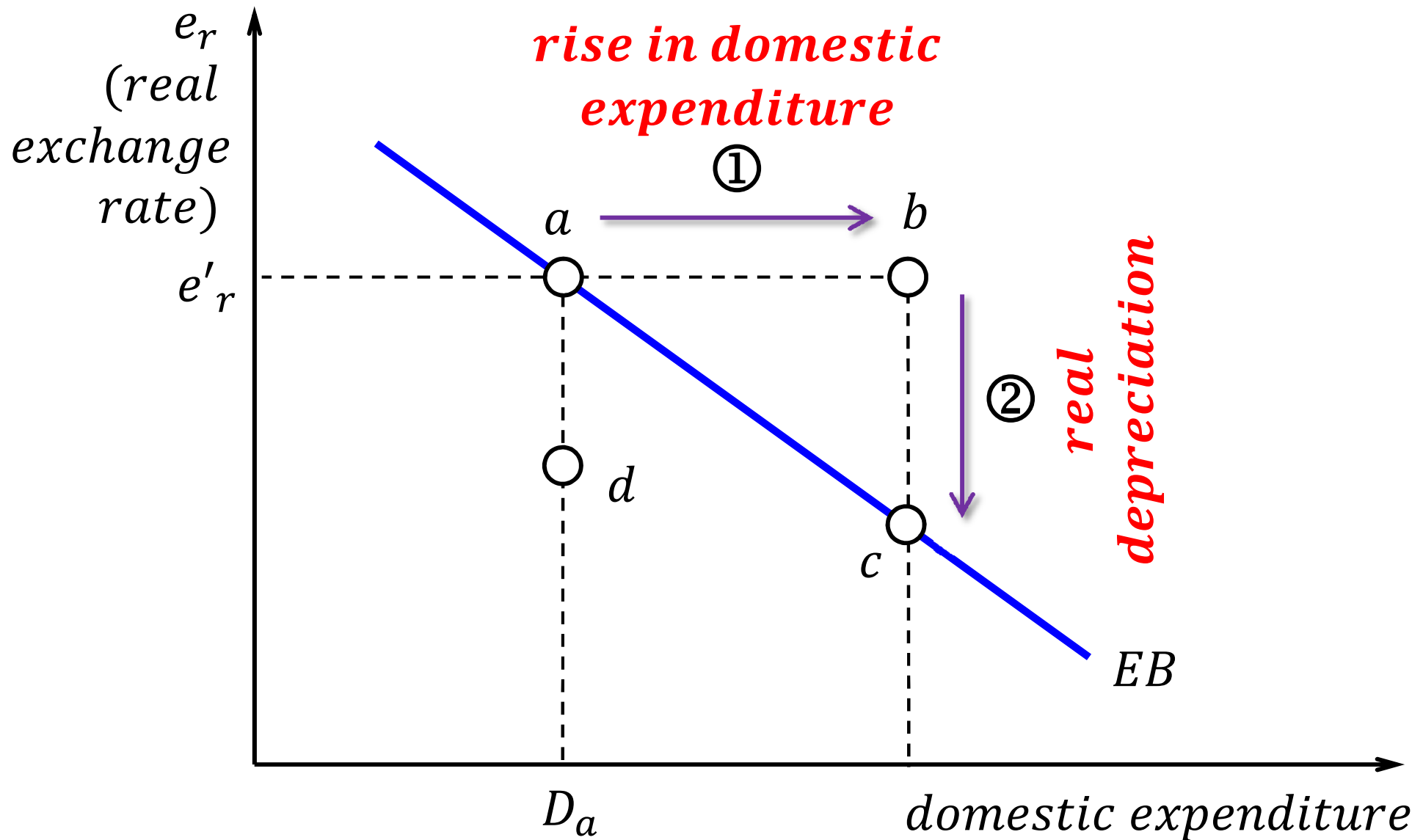
The external balance (EB) function /2

- If follows from the previous analysis that <u>points above the EB function</u> (excessive domestic expenditure) <u>generate a trade deficit</u>.

- Below the EB function failure of external balance is not due to a trade deficit but to <u>trade surplus</u>.

- For instance, at point d, given the corresponding level D_a of domestic expenditure, the real exchange rate is smaller than the value e'_r required to reach external balance with D_a. That is, the economy is too competitive and therefore runs a trade surplus.

Interpreting the EB function /2

e_r
(real exchange rate)

trade deficit

trade surplus

EB

domestic expenditure
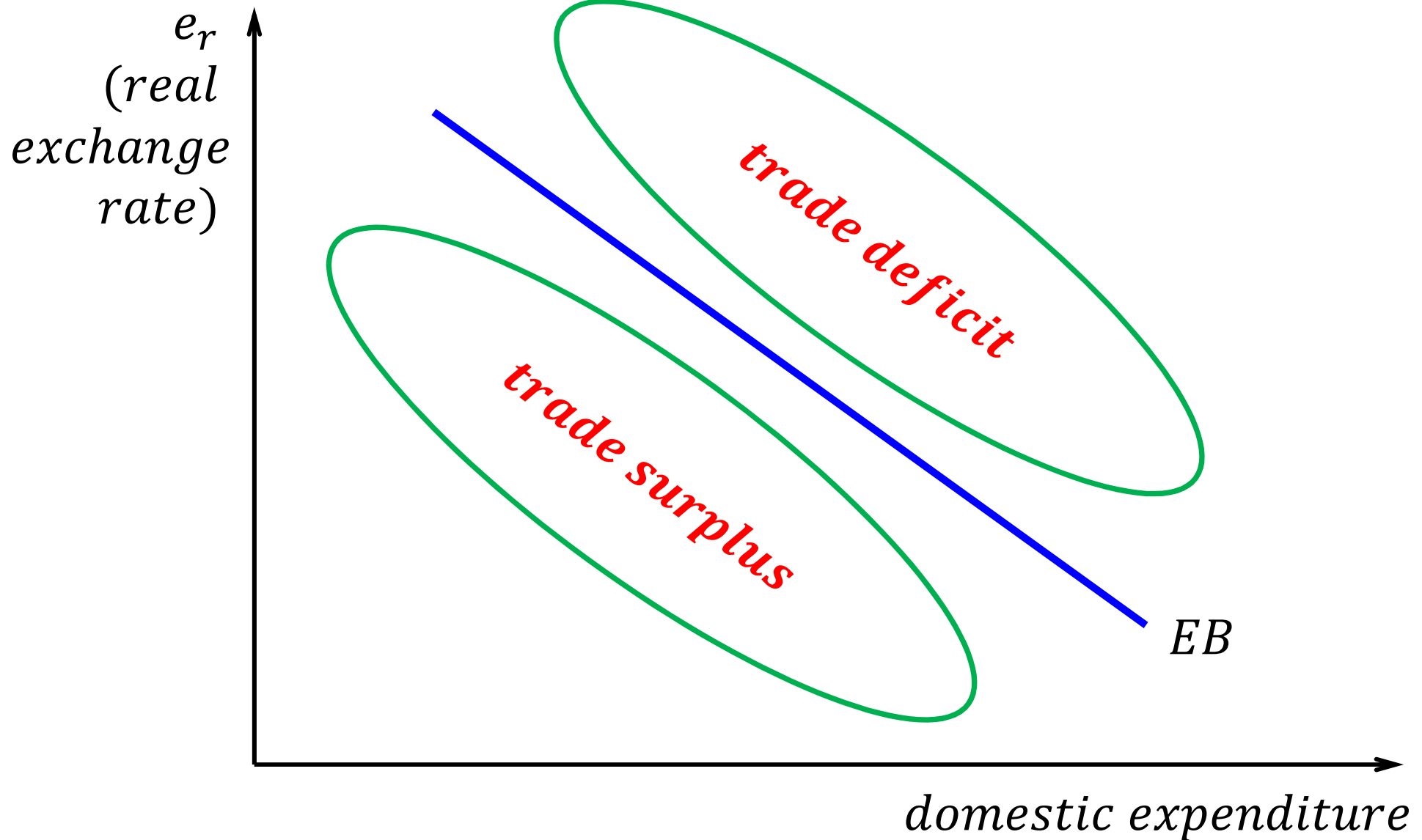
The Swan (or Meade-Swan) diagram

- The Swan diagram (due to Trevor W. Swan) combines the IB and EB functions.

- It separates the plane into four regions.
  - In region I, the economy experiences unemployment and trade deficit (Spain, Egypt, Poland).
  - In region II, inflation coexists with a trade deficit (Brazil, Turkey, Colombia, Morocco).
  - In region III, there is inflation and a trade surplus (China, Russia, Korea).
  - In region IV, the economy has unemployment and runs a trade surplus (Hungary, Slovakia).
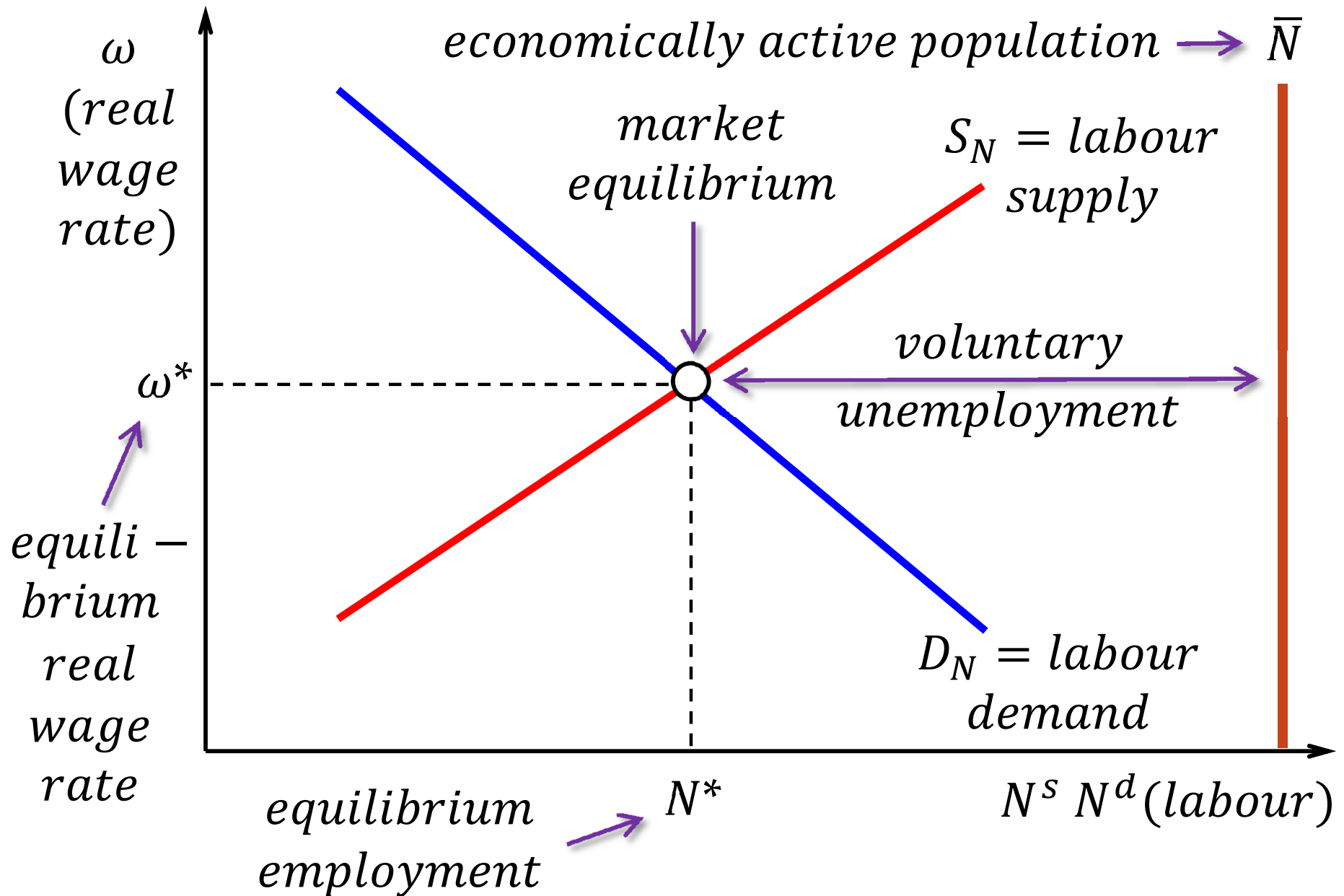
The Swan diagram in action

- Suppose the economy is in Region I and, specifically, around the numeral "I" in "Region I".

- At that point, the economy has unemployment. It may appear that more expenditure is needed to reduce unemployment.

- The diagram suggests that the unemployment problem this economy faces is not solved by changing expenditure (increasing it) but by shifting expenditure. To reach the intersection of the IB and EB lines, domestic expenditure must be reduced and net exports increased (through depreciation).

Involuntary unemployment

- <u>Involuntary unemployment</u> occurs when, at the prevailing wage rate in the economy, there are people willing to work but are not given a job.

- The models developed next illustrate basic reasons for the existence of involuntary unemployment:
  - "too high" wage rates (classical explanation);
  - insufficient labour demand, due to insufficient aggregate demand (Keynesian explanation);
  - existence of market power (trade unions);
  - existence of labour discrimination; and
  - structural reasons (E-PIS model).

The classical labour market model /1

economically active population $\longrightarrow \bar{N}$

ω (real wage rate)

market equilibrium

S_N = labour supply

ω^*

voluntary unemployment

equili − brium real wage rate

D_N = labour demand

N^*

$N^s \ N^d$ (labour)

equilibrium employment

The classical labour market model /2

- It is a standard competitive model in which "price" is represented by the real wage ω (the nominal wage W divided by some price level P) and "quantity" is labour (labour supplied and demanded).

- The higher ω, the higher the labour supply N^s (up to the maximum labour that can be supplied: the economically active population $\overline{N}$). The labour supply function is therefore increasing.

- The labour demand function is decreasing: the higher ω, the lower the labour demand N^d.

Competitive labour demand /1

- A labour demand function can be constructed as follows. Take any firm using labour n to produce a certain commodity X by means of the production function $q(n)$ that establishes the total amount of X that can be produced using n units of labour.

- Define the <u>firm's profit function</u> as $\pi(n) = p \cdot q(n) - W \cdot n$, where n is the amount of labour the firms hires, p is the price at which the firm sells X (in a competitive market for X), and W is the nominal wage (the cost of hiring each unit of labour).

Competitive labour demand /2

- Suppose the aim of the firm is to <u>choose n to maximize the profit function</u>. Assuming the function $q(n)$ differentiable, the first order condition for a maximun is $\frac{d\pi(n)}{dn} = 0$. Since the firm is a price taker in the commodity market,

$$\frac{d\pi(n)}{dn} = p \cdot \frac{dq(n)}{dn} - W = 0 \ .$$

- The derivative $\frac{dq(n)}{dn}$ is the marginal product of labour (MPL). Therefore, $\boxed{MPL(n) = W/p}$ implicitly defines the <u>firm's labour demand function</u>.

Competitive labour demand /3

- $MPL(n)$ is typically supposed to be <u>decreasing</u>: the more labour is hired, the smaller the contribution that the last unit makes to production (<u>each additional unit of labour is less productive</u>).

- As a result, when represented graphically in the space $(\frac{W}{p}, n)$, the function $\frac{W}{p} = MPL(n)$ is decreasing. This says that the firm hires labour until its marginal product coincides with the real cost of hiring labour (the real wage $\frac{W}{p}$). Equivalently, <u>labour is paid according to the value of its marginal productivity</u>: $W = p \cdot MPL(n)$.

Example

- If $q(n) = 2 \cdot n^{1/2}$, $MPL(n) = \frac{dq(n)}{dn} = 2 \cdot \frac{1}{2} \cdot (n)^{\frac{1}{2}-1} = n^{-1/2} = \frac{1}{n^{1/2}}$. The firm's labour demand function is

$$MPL(n) = \frac{W}{p}$$

Labour demand stimulated by a rising price of the product or a falling wage rate

- Therefore, $\frac{1}{n^{1/2}} = \frac{W}{p}$. Solving for n,

$$n = \frac{1}{(W/p)^2} \quad or \quad \boxed{n = \frac{p^2}{W^2}.}$$

- Since $\frac{dn}{d(W/p)} = -\frac{2}{(W/p)^3} < 0$, the demand for labour is a decreasing function of the real wage W/p.
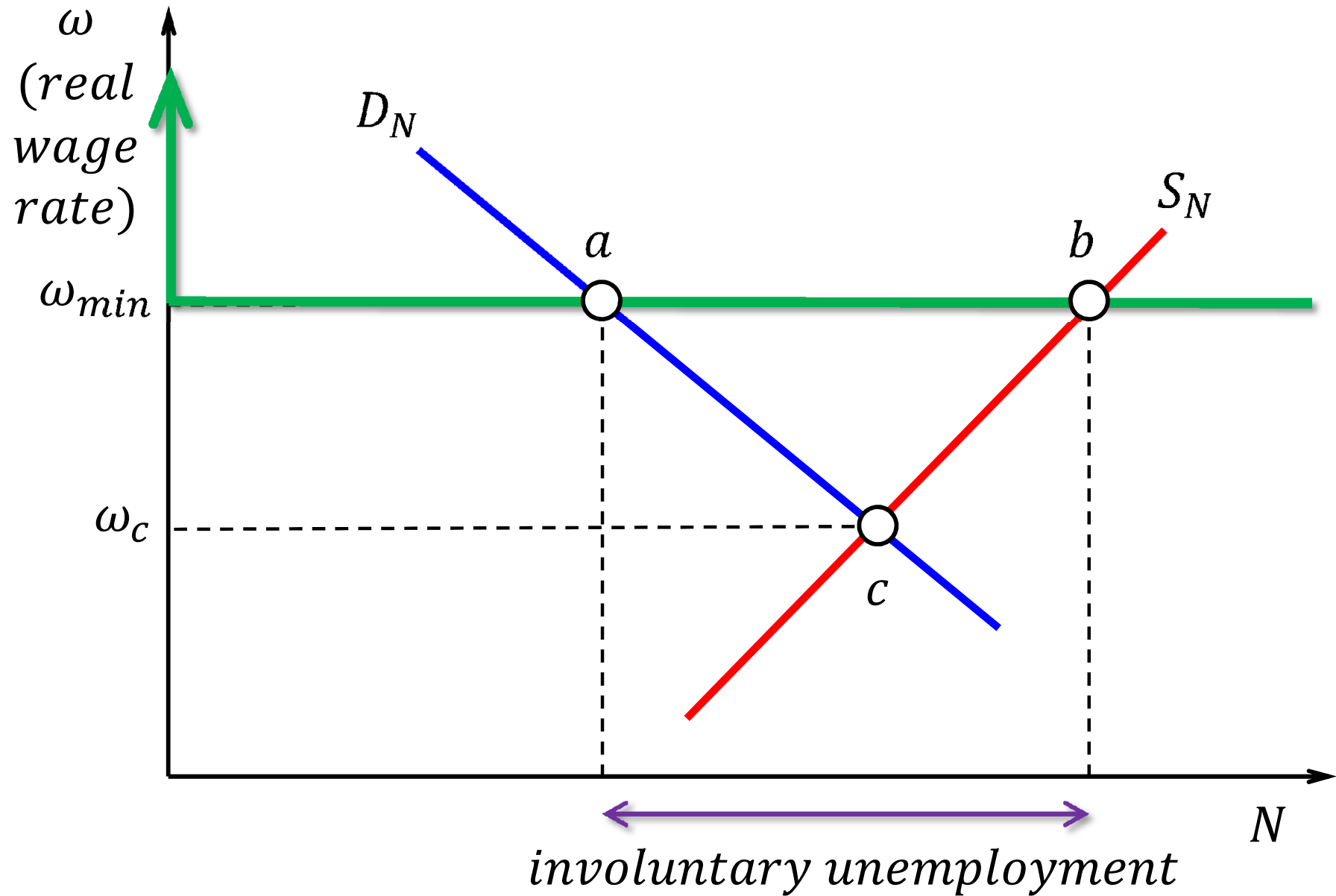
Equilibrium in the labour market

- Since the labour demand of each firm is inversely correlated with a certain wage rate, one may jump to the conclusion that the aggregate demand for labour in an economy is inversely correlated with the economy's real wage.

- The equilibrium real wage rate ω^* is such that labour supplied at ω^* equals labour demanded at ω^*. Given ω^*, <u>there is no involuntary unemployment</u>: everyone willing to get hired at ω^* is hired. The difference $\overline{N} - N^*$ can be viewed as voluntary unemployment ($\frac{N^*}{\overline{N}}$ would be the participation rate).

Unemployment in the classical model /1

- Establishing a mininum real wage ω_{min} above the equilibrium wage rate ω^* generates involuntary unemployment in a competitive labour market.

- The next slide illustrates this possibility. Market equilibrium occurs at point c. If the minimum wage rate ω_{min} is set, the market state is no longer represented by c but by a: although workers are willing to be at b, firms cannot be forced to hire more workers than the amount given by a.

- At the prevailing wage rate ω_{min} there is an excess supply, interpreted as involuntary unemployment.

Unemployment in the classical model /2

Unemployment in the classical model /3

- Involuntary unemployment in a competitive labour market may also temporarily arise if the real wage rate adjusts sluggishly.

- The next slide illustrates this situation. Market equilibrium occurs initially at a, with wage rate ω_a. The demand for labour function shifts to the left. The new equilibrium would be represented by c.

- But if the real wage rate takes time to adjust (decrease), the wage rate in the market may temporarily remain at the initial level ω_a. The market is then at b, where involuntary unemployment exists.

Unemployment in the classical model /4
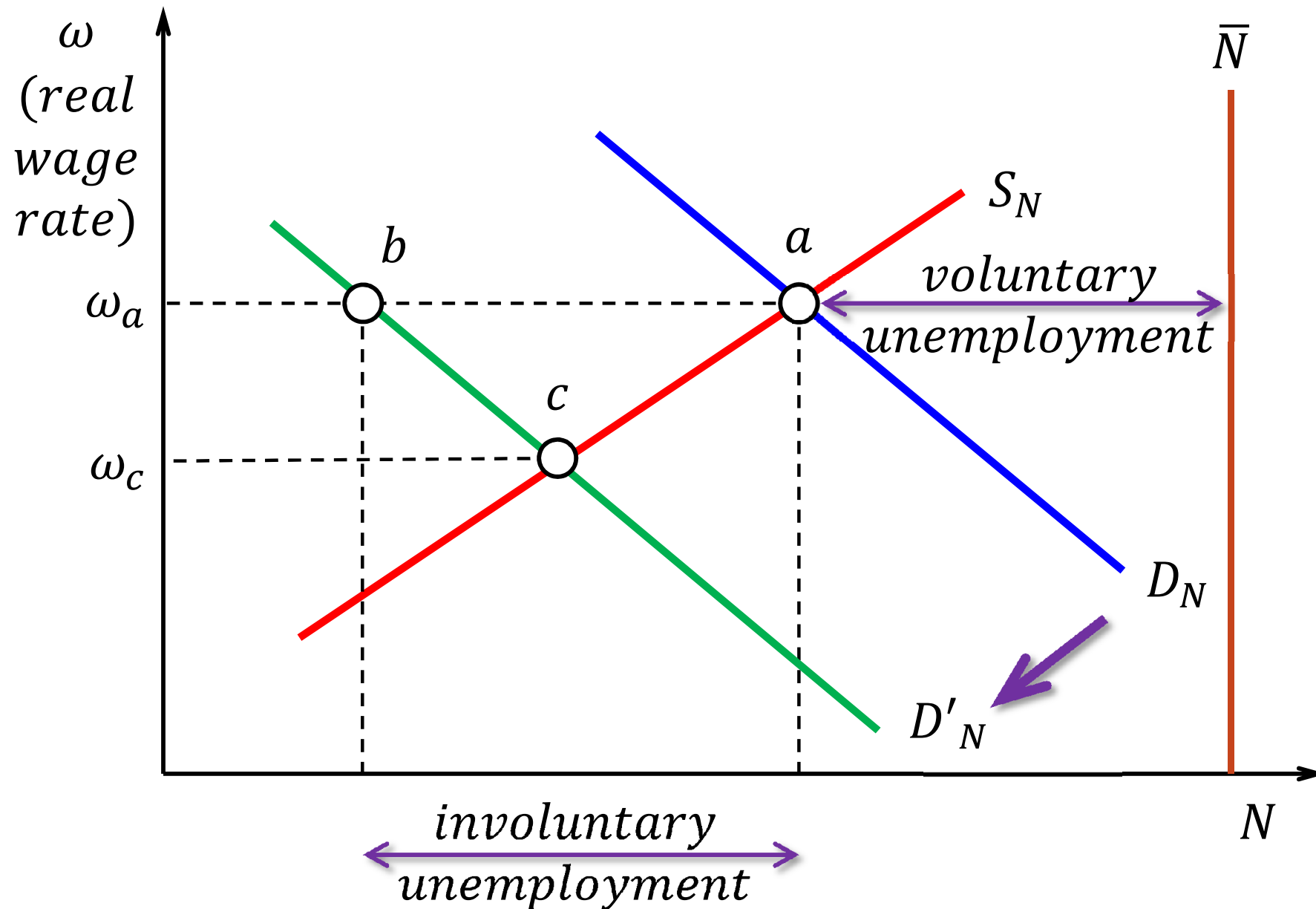
An atypical example /1

- Suppose the S^N function combines a flat with an upward sloping section, as shown in the next slide.

- The flact section at real wage ω^* could be interpreted in the sense that, when the real wage is ω^*, (i) workers are, in principle, indifferent between supplying labour or not, and (ii) some random variable determines the amount actually supplied.

- Market equilibrium occurs at a, where employment is N^*. If workers finally choose to supply N' (effective labour supply represented by b), there is involuntary unemployment given by $N' - N^*$.

An atypical example /2
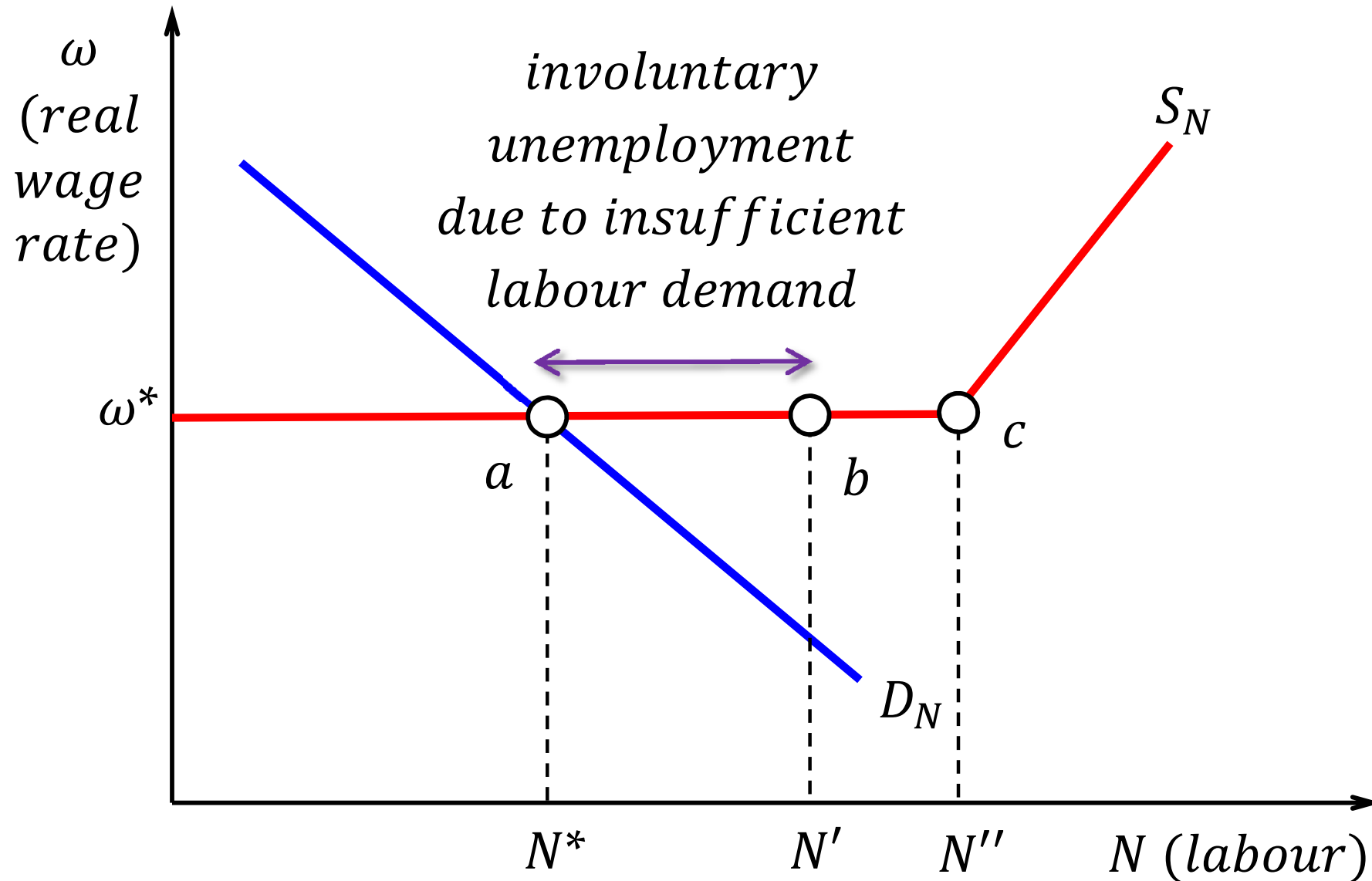
(Derived) demand for labour

- Firms do not hire workers because they aim at accumulating workerts. The labour forces is a tool to produce commodities and obtain a profit by selling the commodities produced.

- For that reason, it is said that the demand for labour by firms is a <u>derived demand</u>: it arises as an intermediate step in the process of reaching the firms' final goal, which is making profits.

- Hence, <u>the demand for labour crucially depends on sales expectations</u>: no matter how "cheap" labour is, workers will not be hired if firms do not expect to sell what these workers would produce.

Supply-side market power: unions /1

- The monopsony analysis shows that demand-side market power generates less employment and lower wages than perfect competition.

- Supply-side market power is typically associated with the existence of trade unions. For any given amount of labour *N,* the wage rate unions demand to supply *N* will be higher than the wage rate dictated by the supply of labour function.

- This follows from the fact that <u>unions</u> (since they can organize strikes) <u>have more bargaining power over wages than individual workers</u>.

Supply-side market power: unions /2

- As a result, the function S_{UNIONS} associating with each amount of labour N the wage rate that unions will ask to be willing to supply N must lie above the supply of labour function.

- The next slide combines the function S_{UNIONS} with a competitive labour demand function D_N. Without trade unions, market equilibrium is at c. With unions market equilibrium is at u. The distance between u and v represents involuntary unemployment: given wage ω_u, workers would individually like to supply N_v but the presence of the union only allows N_u to be hired.

Supply-side market power: unions /3
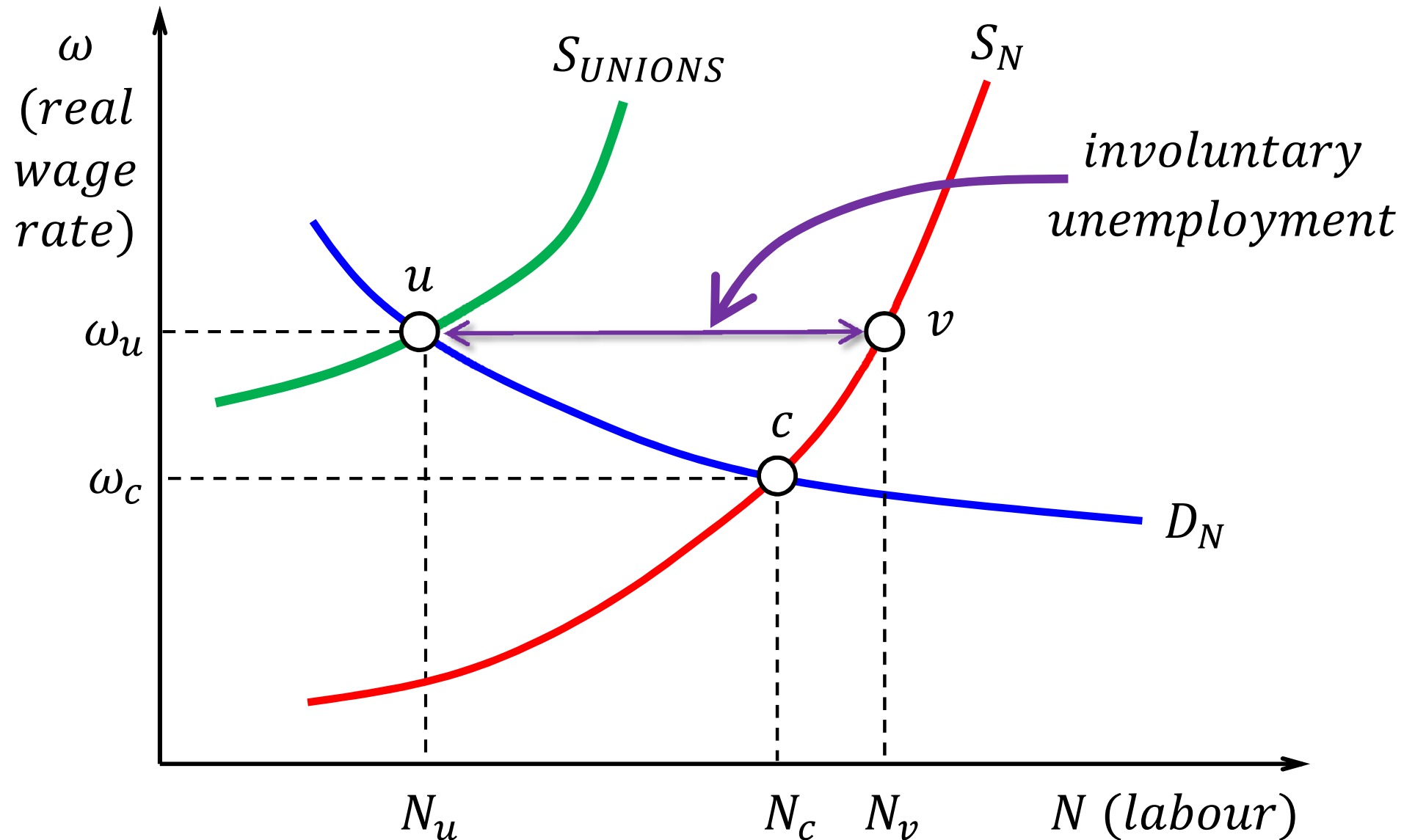
Fighting involuntary unemployment

- When the wage is "too high", the obvious solution to get rid of unemployment is to lower the wage (or let time pass by for the wage to adjust by itself).

- When unemployment is due to lack of labour demand, the natural solution is an aggregate demand expansion that induces firms to hire more workers to satisfy the additional demand.

- When the cause of unemployment is market power (unions), the solution seems harder to implement: how to reduce the unions' bargaining power without raising protests by part of the workers?

http://en.wikipedia.org/wiki/Trade_unions_in_the_United_Kingdom

31 March 2016

Price setting & wage setting model /1

- In modern economies, the nominal wage rate of a substantial number of workers is determined through <u>collective bargaining involving unions</u>.

- If workers are represented by unions, at any level of employment, the real wage will be above the wage rate dictated by the labour supply function.

- It is assumed that unions establish the real wage using a wage setting function WS sloping upward and lying above the labour supply function S_N. The higher the unions' bargaining power, the larger the vertical distance between between WS and S_N.

Price setting & wage setting model /2

- Whereas workers (through unions) are assumed to set the nominal wage, firms are supposed to fix the prices of the commodities they produce.

- A simple price setting rule consists of adding a mark-up $\hat{\mu} > 0$ to labour costs: $P = (1 + \hat{\mu}) \cdot \dfrac{W}{MPL}$.

- W is measured in money (EUR) and MPL in units of product per worker. Thus, $\dfrac{W}{MPL}$ is the money paid to workers divided by what they produce. In other words, $\dfrac{W}{MPL}$ is the (labour) cost of producing a unit of the commodity.

Price setting & wage setting model /3

- It follows from $P = (1 + \tilde{\mu}) \cdot \frac{W}{PMT}$ that $\frac{1}{1+\tilde{\mu}} \cdot PMT = \frac{W}{P}$. As $\tilde{\mu} > 0$, $\frac{1}{1+\tilde{\mu}} < 1$. Therefore, for some $\mu > 0$, $\frac{1}{1+\tilde{\mu}} = 1 - \mu$. Thus, $(1 - \mu) \cdot PMT = \frac{W}{p}$. In sum,

$$ \underbrace{MPL}_{\substack{\text{production} \\ \text{per worker}}} = \underbrace{\frac{W}{p}}_{\substack{\text{real wage} \\ \text{per worker}}} + \underbrace{\mu \cdot MPL}_{\substack{\text{real profit} \\ \text{per worker}}}. $$

- μ is then a <u>mark-up over output</u>: the fraction of the workers' productivity that the firm appropriates.

Price setting & wage setting model /4

- Under perfect competition in the labour and product markets, $\dfrac{W}{p} = MPL$.

- When prices are set by firms as the marking up of labour costs per worker, $\dfrac{W}{p} = (1 - \mu) \cdot MPL$. This is called the <u>price setting function</u> PS. As $0 < \mu < 1$, $\dfrac{W}{p} = (1 - \mu) \cdot MPL$ means that $\dfrac{W}{p} < MPL$.

- As the MPL function is <u>downward sloping</u>, the PS function is downward sloping as well. PS <u>lies below</u> MPL because PS is a fraction of MPL (the constant $1 - \mu$ is smaller than 1).

The WS and PS model
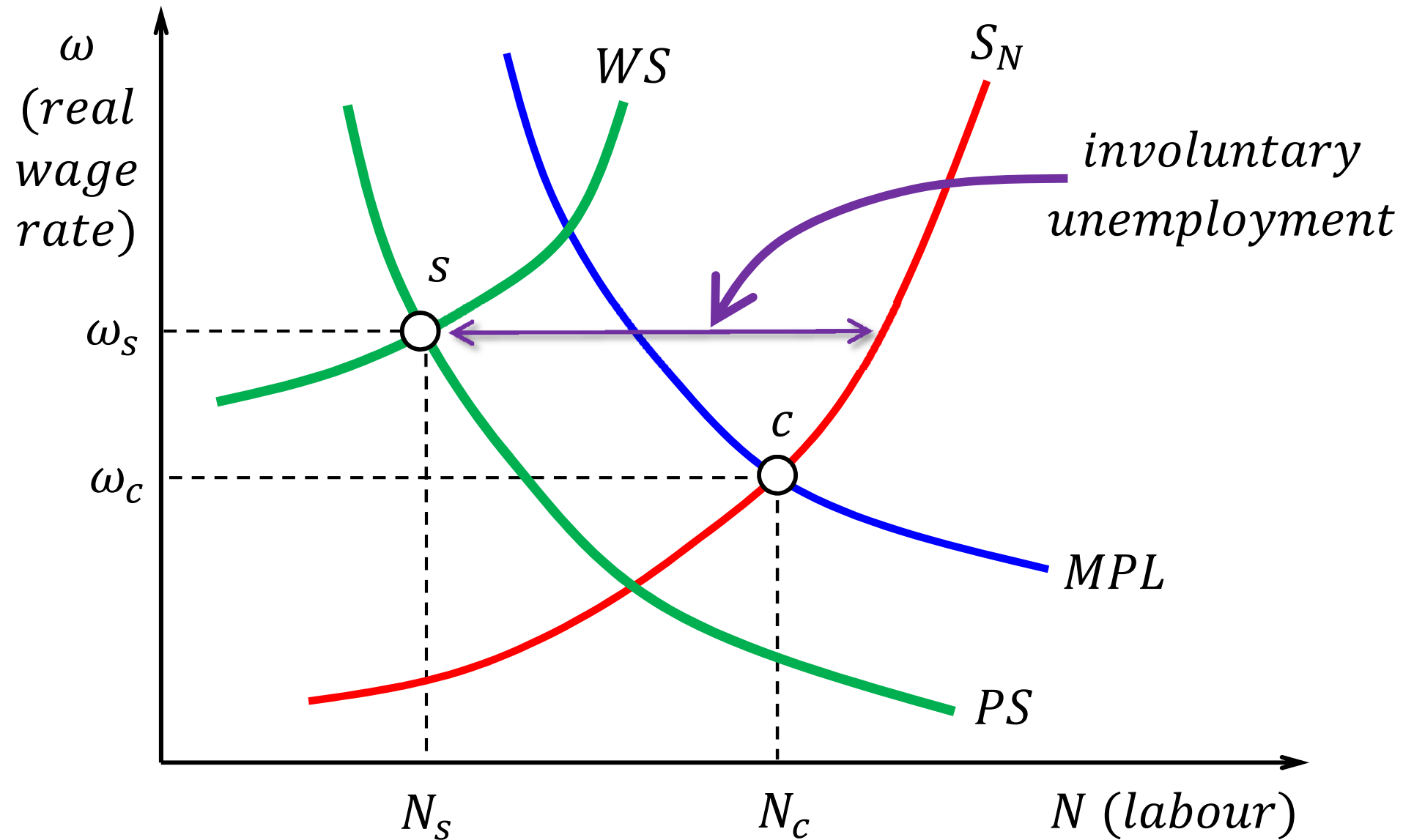
Example

- Supply of labour function: $\omega = \frac{5}{3} \cdot N$ (ω is the real wage rate).

- MPL function: $MPL = 20 - 5 \cdot N$.

- Demand for labour function: $\omega = MPL$.

- WS function: $\omega = 3 \cdot N$.

- PS function: $\omega = (1 - \mu) \cdot MPL$, with $\mu = 0.4$.

- Competitive solution: $\frac{5}{3} \cdot N = 20 - 5 \cdot N \implies N = 3$ and $\omega = 5$.

- WS - PS solution: $3 \cdot N = 0.6 \cdot MPL \implies 3 \cdot N = 0.6 \cdot (20 - 5 \cdot N) \implies N = 2$ and $\omega = 6$.

Segmented labour market model

- Suppose workers may have or not some economically irrelevant feature that firms may like or not (for instance, being a man or not).

- Firms classify workers in two types (I and II) depending on whether they possess the feature or not. Some firms (type I firms) prefer type I workers; the rest (type II) prefer type II workers.

- Each type of firms defines a different (competitive) labour market. Workers are unaware of the fact that there are two types of firms. From their perspective, the labour market is not segmented.
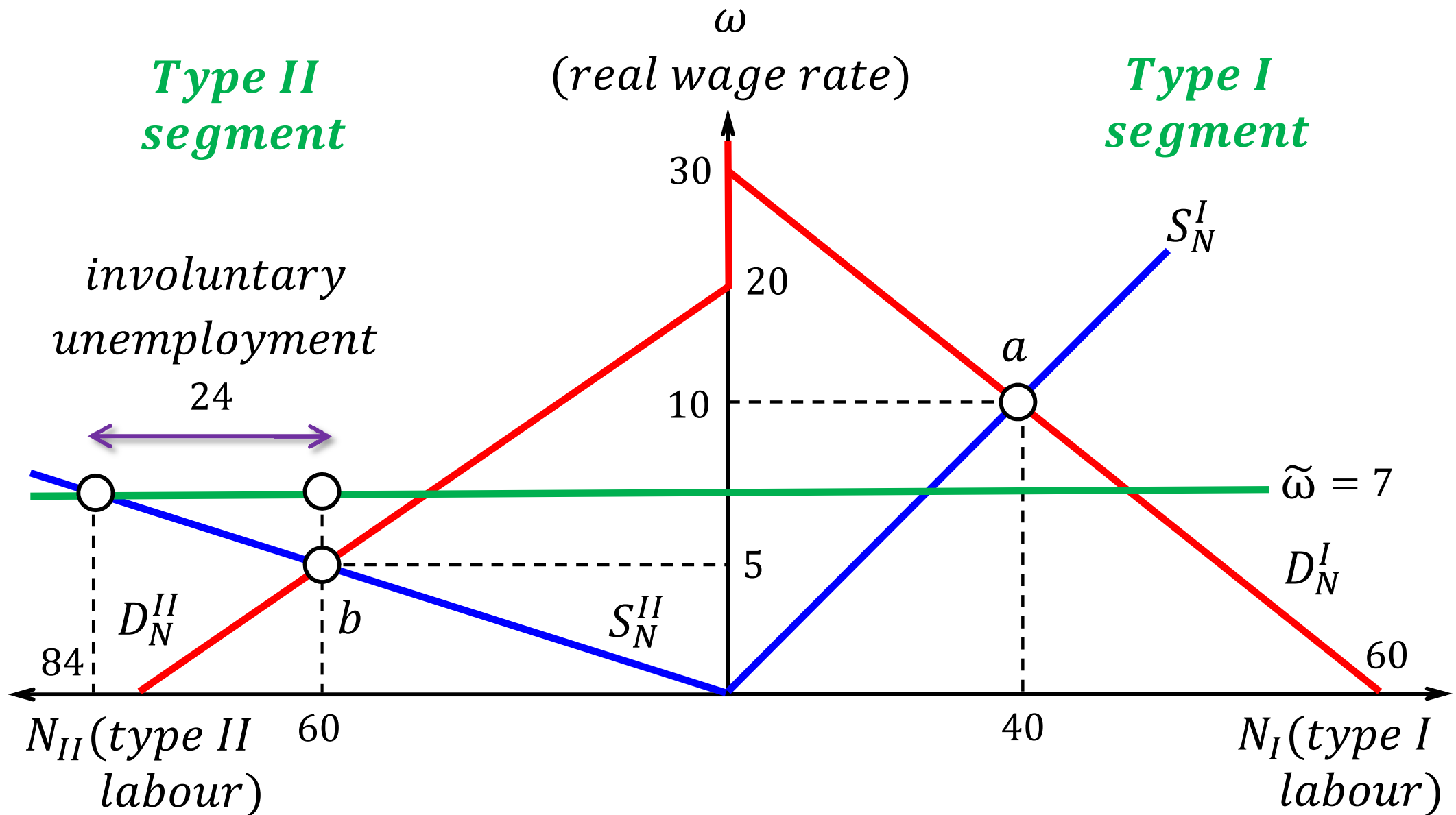
Example /1

- Supply of labour function of type I workers: $S_N^I = 4 \cdot \omega$ (ω is the real wage rate).

- Demand for labour function of type I firms: $D_N^I = 60 - 2 \cdot \omega$ ($N_I^d = 0$ if $\omega > 30$).

- Market equilibrium (type I): $(N_I, \omega_I) = (40, 10)$.

- Supply of labour function of type II workers: $S_N^{II} = 12 \cdot \omega$.

- Demand for labour function of type II firms: $D_N^{II} = 80 - 4 \cdot \omega$ ($N_{II}^d = 0$ if $\omega > 20$).

- Market equilibrium (type II): $(N_{II}, \omega_{II}) = (60, 5)$.

Example /2

- $\frac{40}{40+60} = \frac{2}{5} = 40\%$ of employment corresponds to type I workers and $\frac{60}{40+60} = \frac{3}{5} = 60\%$ to type II. Using these weights, the average real wage rate would be $\widetilde{\omega} = \frac{2}{5} \cdot \omega_I + \frac{3}{5} \cdot \omega_{II} = \frac{2}{5} \cdot 10 + \frac{3}{5} \cdot 5 = 7$.

- At $\widetilde{\omega} = 7$, no more type I workers than are actually employed would like to be hired. But, at $\widetilde{\omega} = 7$, type II workers would like to supply $S_N^{II} = 12 \cdot \widetilde{\omega} = 84$. Since employment of type II workers equals $N_{II} = 60$, involuntary unemployment appears to be $S_N^{II}(\widetilde{\omega} = 7) - N_{II} = 84 - 60 = 24$ (unemployment rate $= 24/(24 + N_I + N_{II}) = 19.3\%$); see next slide.

Though each segment is in equilibrium, there is a sense in which involuntary unemployment exists.

ω
(real wage rate)

Type II segment

Type I segment

involuntary unemployment

24

S_N^I

30

20

a

10

$\tilde{\omega} = 7$

D_N^I

5

D_N^{II}

b

S_N^{II}

84

60

N_{II} *(type II labour)*
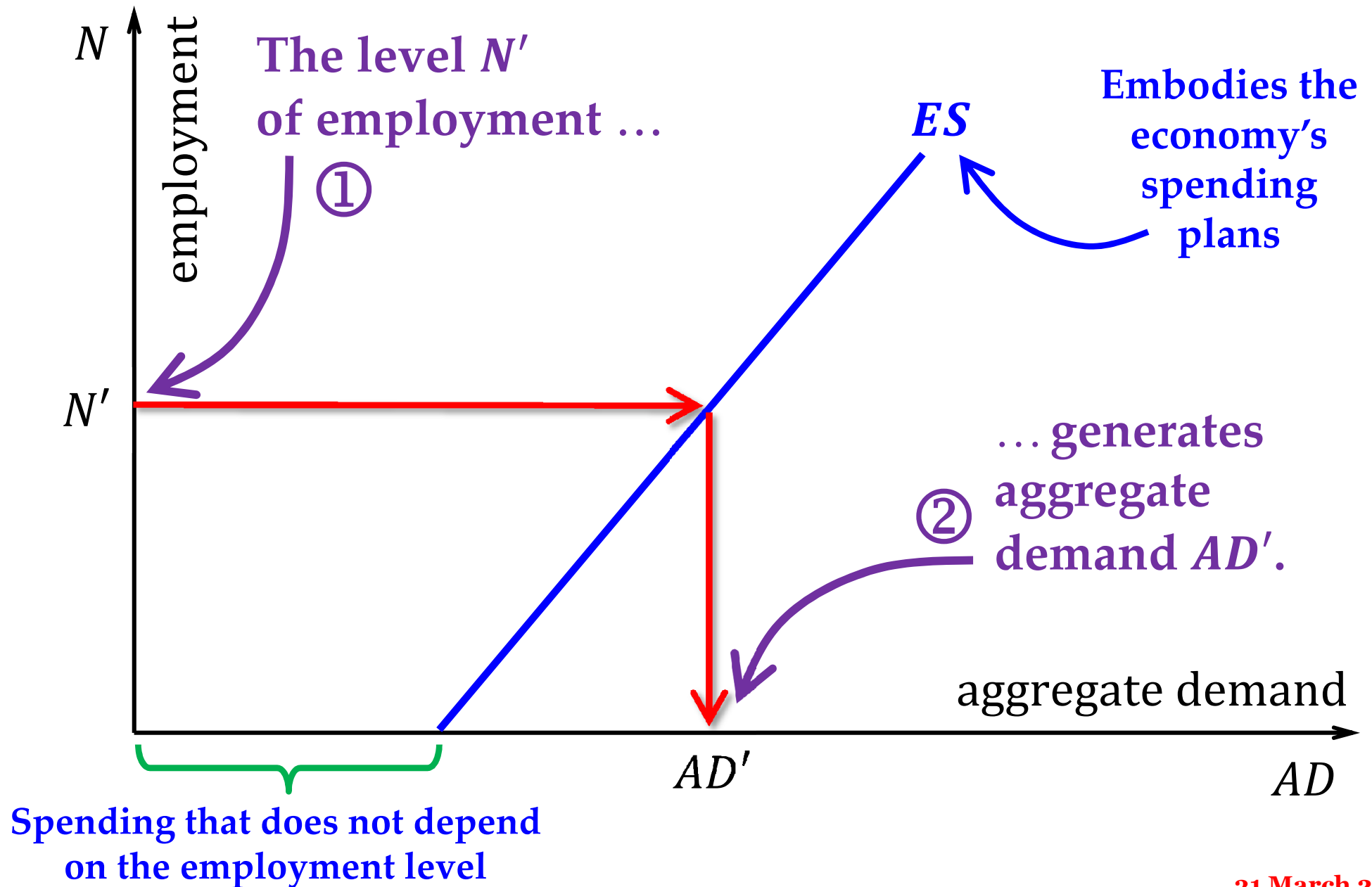
60

40

N_I *(type I labour)*

The E-PIS model

- It postulates three <u>linear</u> relations linking <u>employ-ment</u> with <u>production, income, and spending</u>.

  - *EP* relation (production → employment): esta-blishes the amount of employment required to reach a certain GDP level.

  - *EI* relation (income → employment): identifies the amount of labour supplied for every value of aggregate income.

  - *ES* relation (employment → expenditure): indi-cates the aggregate level of spending associated with any given amount of employment.

EP (employment-production) relation

To reach GDP level Y', firms require the amount N' of labour.

②

EP

Embodies the economy's aggregate production function

N

employment

N'

Firms expect aggregate demand to be Y'. They therefore make plans to produce the amount Y'.

①

GDP

Y'

Y
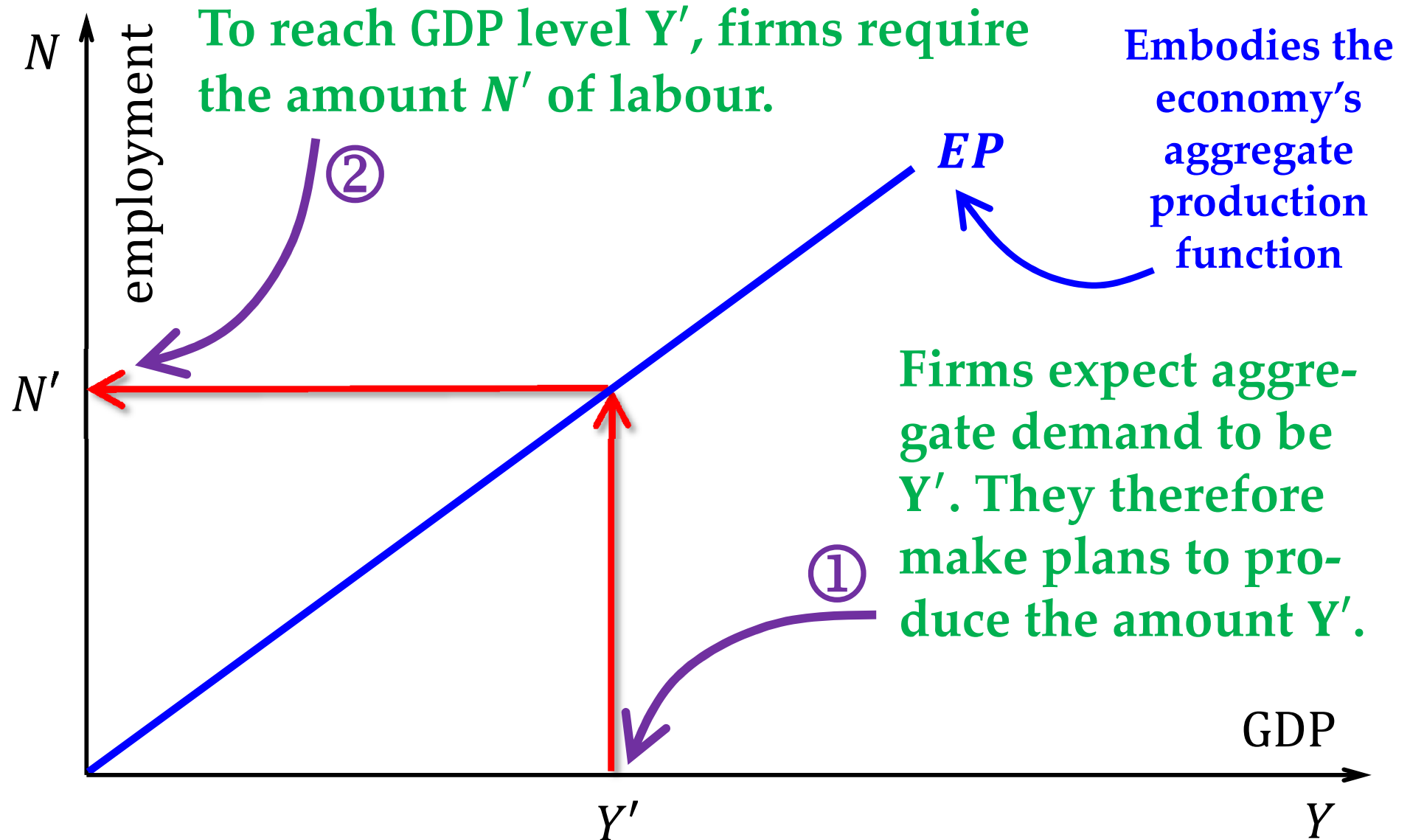
ES (employment-spending) relation

The level N' of employment … ①

ES

Embodies the economy's spending plans

N (employment)

N'

… generates aggregate demand AD'. ②

aggregate demand

AD'

AD

Spending that does not depend on the employment level

EI (employment-income) relation

N

labour

... the amount N' of labour is supplied.

②

EI

Embodies the economy's supply of labour

N'

When the economy ① generates income Y'...

aggregate income

Y'

Y

Insufficient income to supply labour
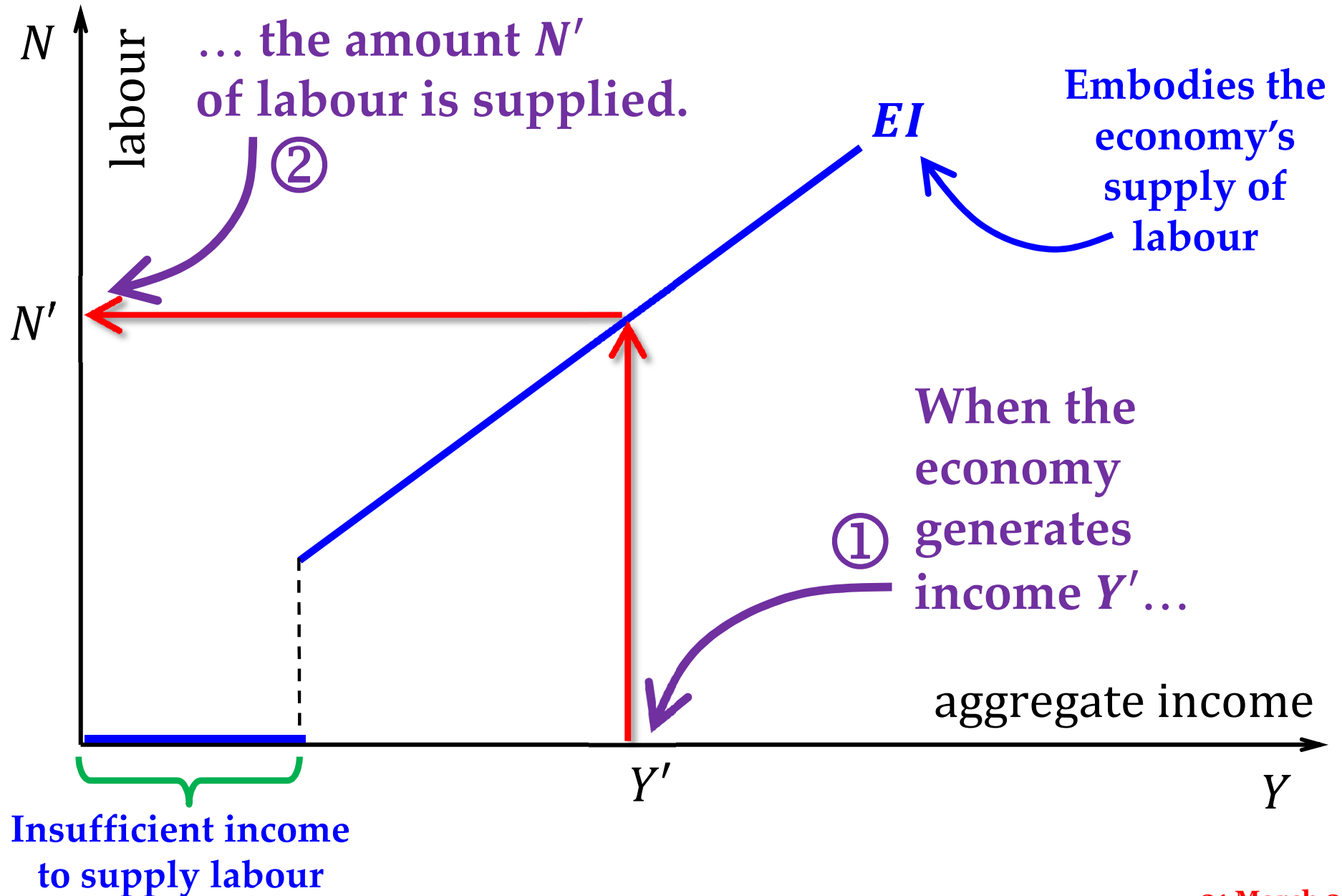
Solving the E-PIS model /1
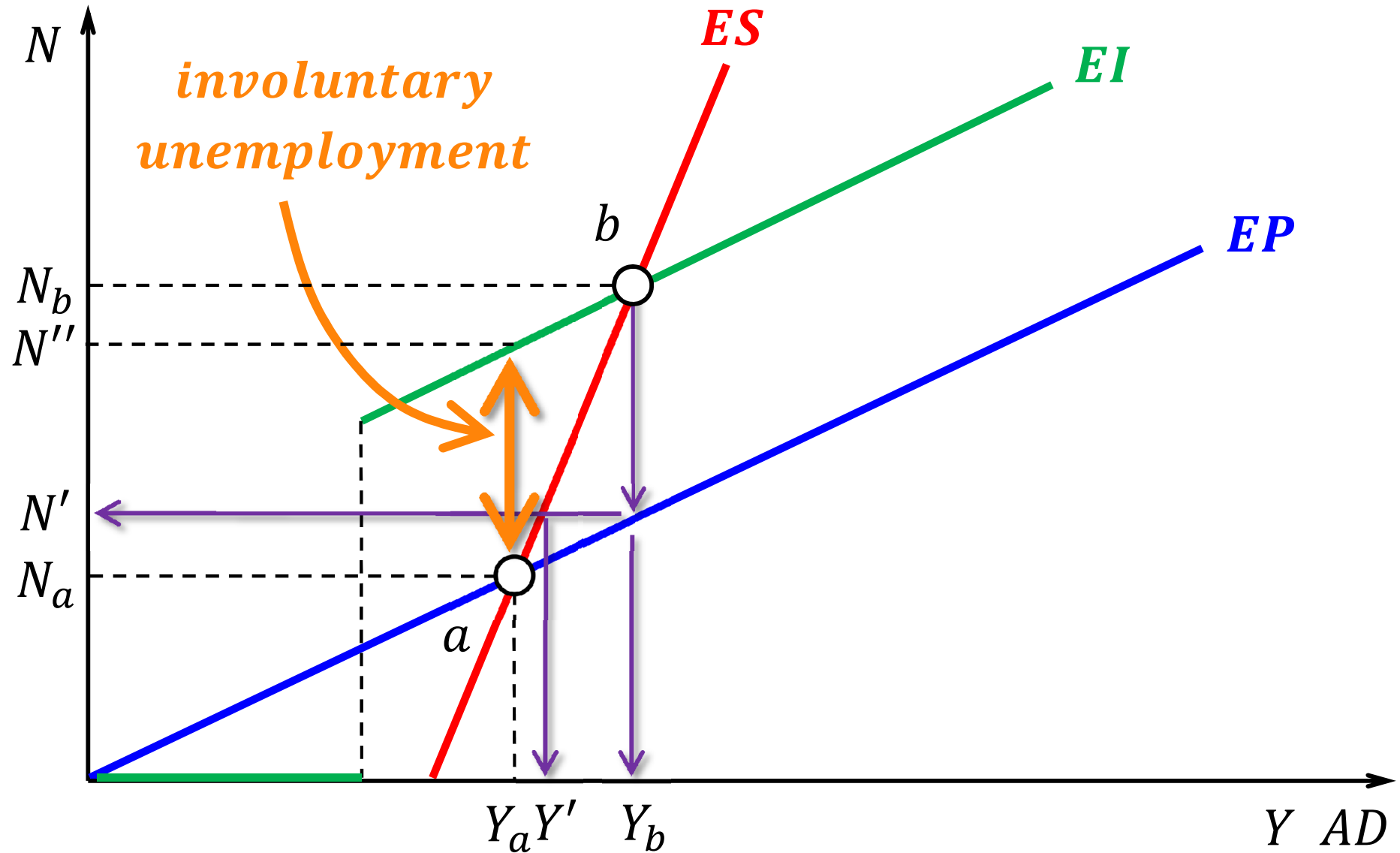
Solving the E-PIS model /2

- 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.
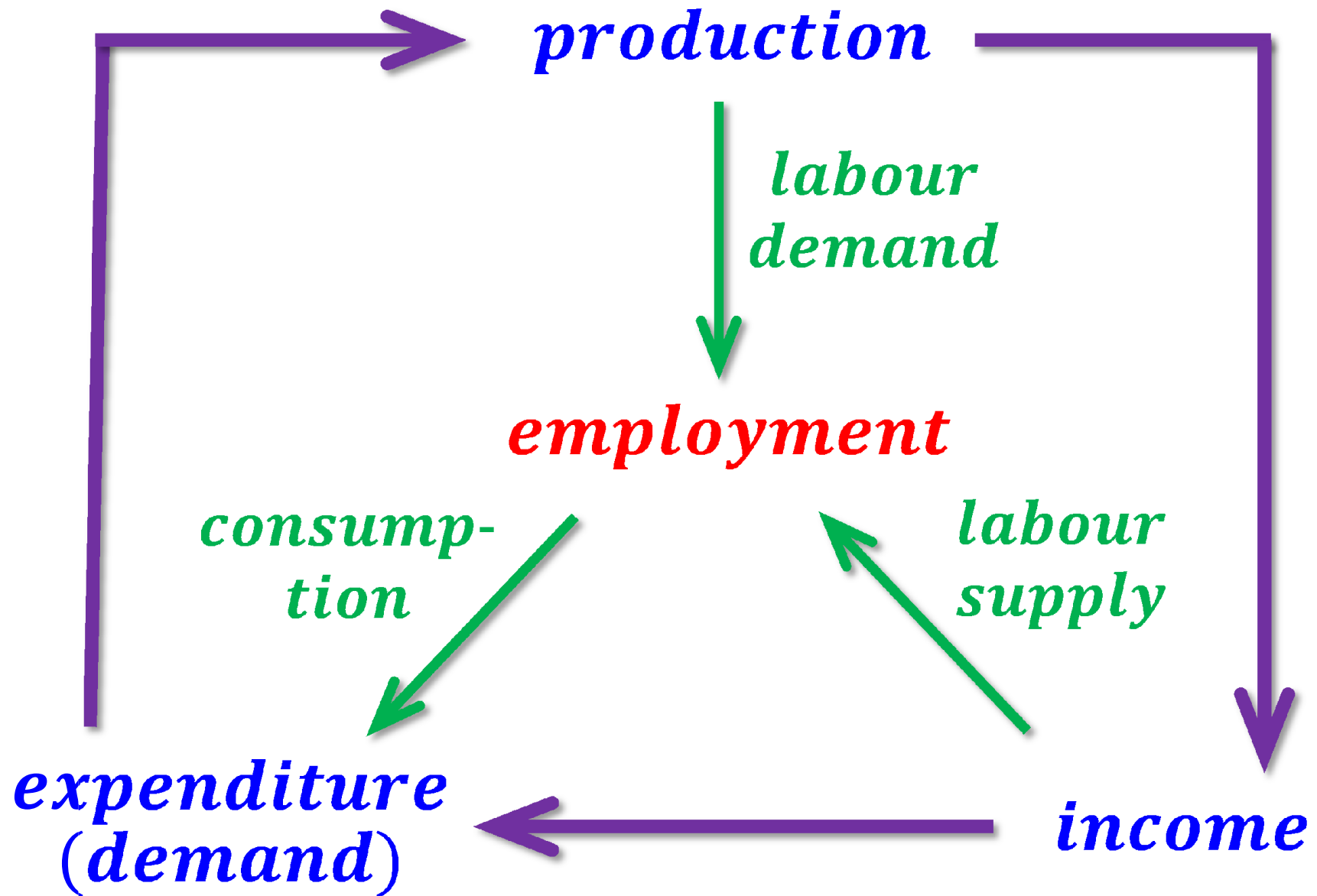
Solving the E-PIS model /3

- 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 <u>there is involuntary unemployment</u> 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 <u>description of an economy</u> is given by the loop

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

- <u>The E-PIS model inserts labour in this loop</u>. 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.

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.