Intermediate Macroeconomics
Sample Teaching Slides I

Q1. CONSUMER BEHAVIOUR

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$$\boldsymbol{= w(1-t)(h-l)}$$

where t is the tax rate.

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- Explain your results in terms of income (IE) and substitution (SE) effects.

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Two factors affecting the consumer's decision-making process:

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   - Before tax: $C = w(h - l) + \pi - T$

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   Clearly, $\boldsymbol{(1 - t)w < w}$.

   Tax changes the relative price of leisure (i.e., the slope of the budget constraint).

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- Income Effect (IE) has to do with how **a change in real income** (feeling richer or poorer) affects the consumption of c and l (both are normal goods).

- Example:
  Since $(1-\mathrm{t})\mathrm{w} < \mathrm{w} \rightarrow \boldsymbol{negative\ IE} \rightarrow lower\ consumption\ of\ both\ c\ and\ l$.
  Less l (leisure) means more time spent working ($h \uparrow$).

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This results in two effects: **Income Effect** (IE) and **Substitution Effect** (SE).

- Substitution Effect (SE) focuses on the **price effect** - specifically, the relative price of leisure (l) with respect to consumption (c).

- For example,
  $w \uparrow (P_l \uparrow)$: *leisure* becomes more expensive (opportunity cost rises) relative to *consumption*
  → $l \downarrow$ and work more ($h \uparrow$) while $c \uparrow$

  $w \downarrow (P_l \downarrow)$: *leisure* becomes cheaper (opportunity cost falls) relative to *consumption*
  → $l \uparrow$ and work less ($h \downarrow$) while $c \downarrow$

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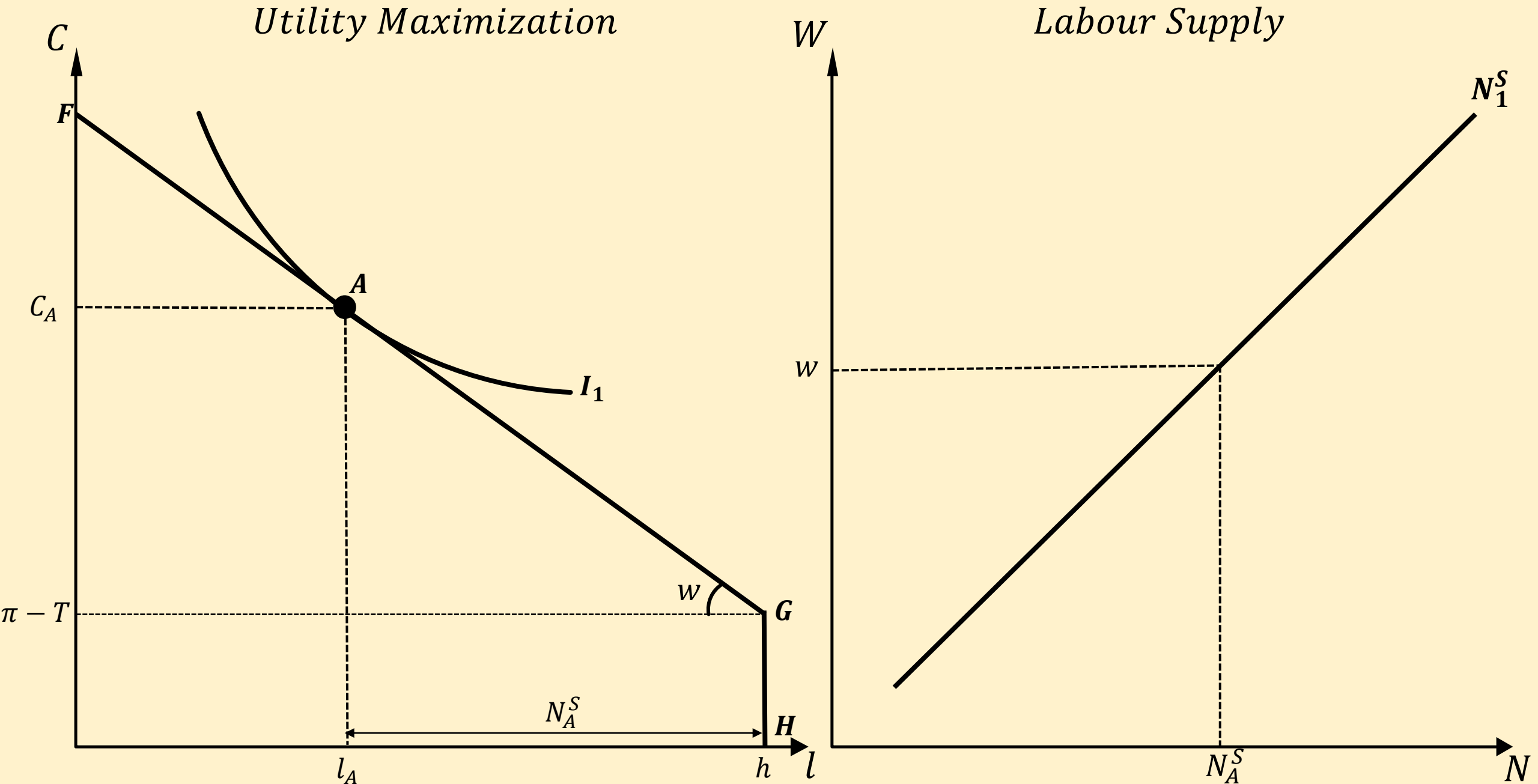

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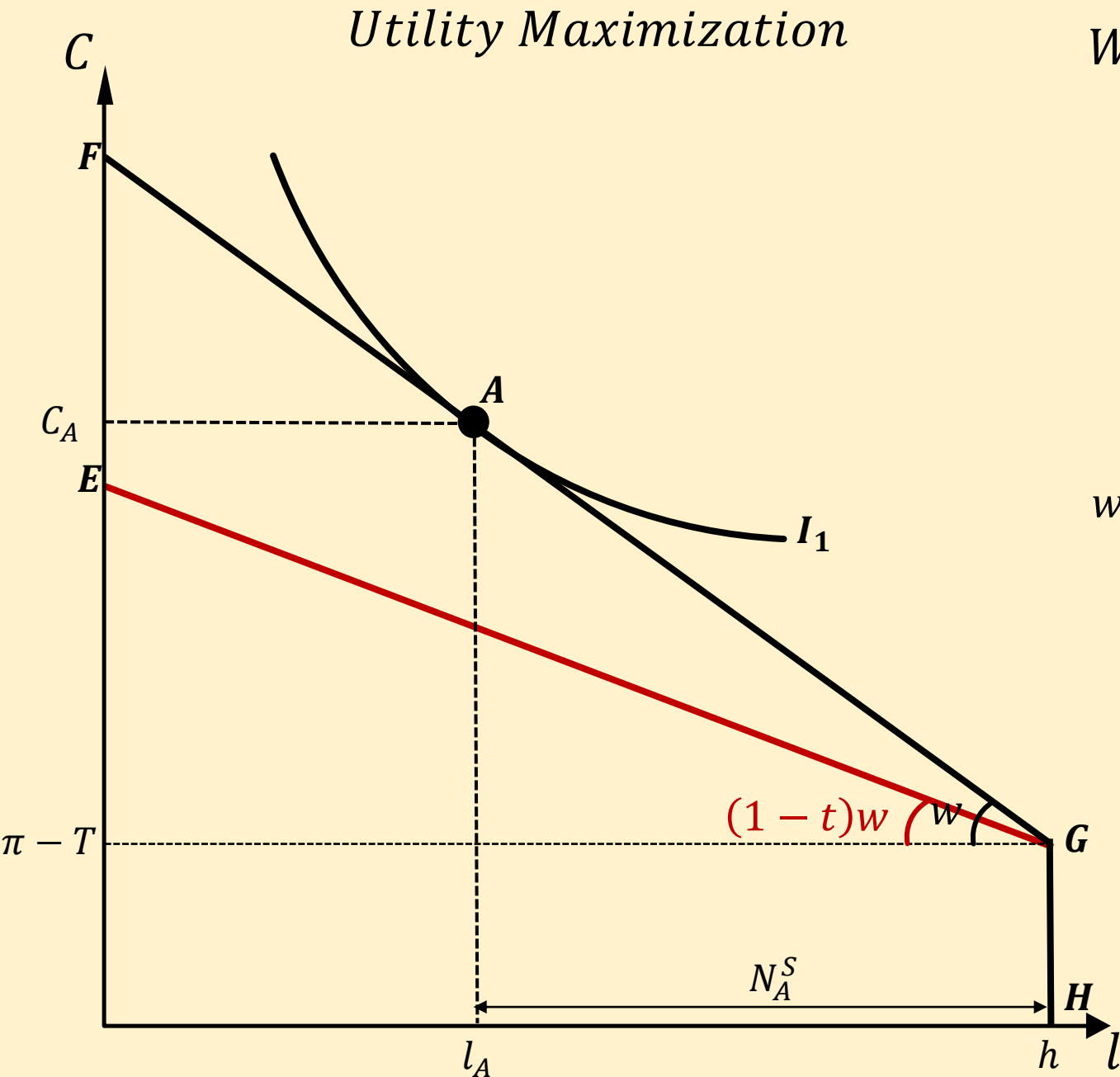

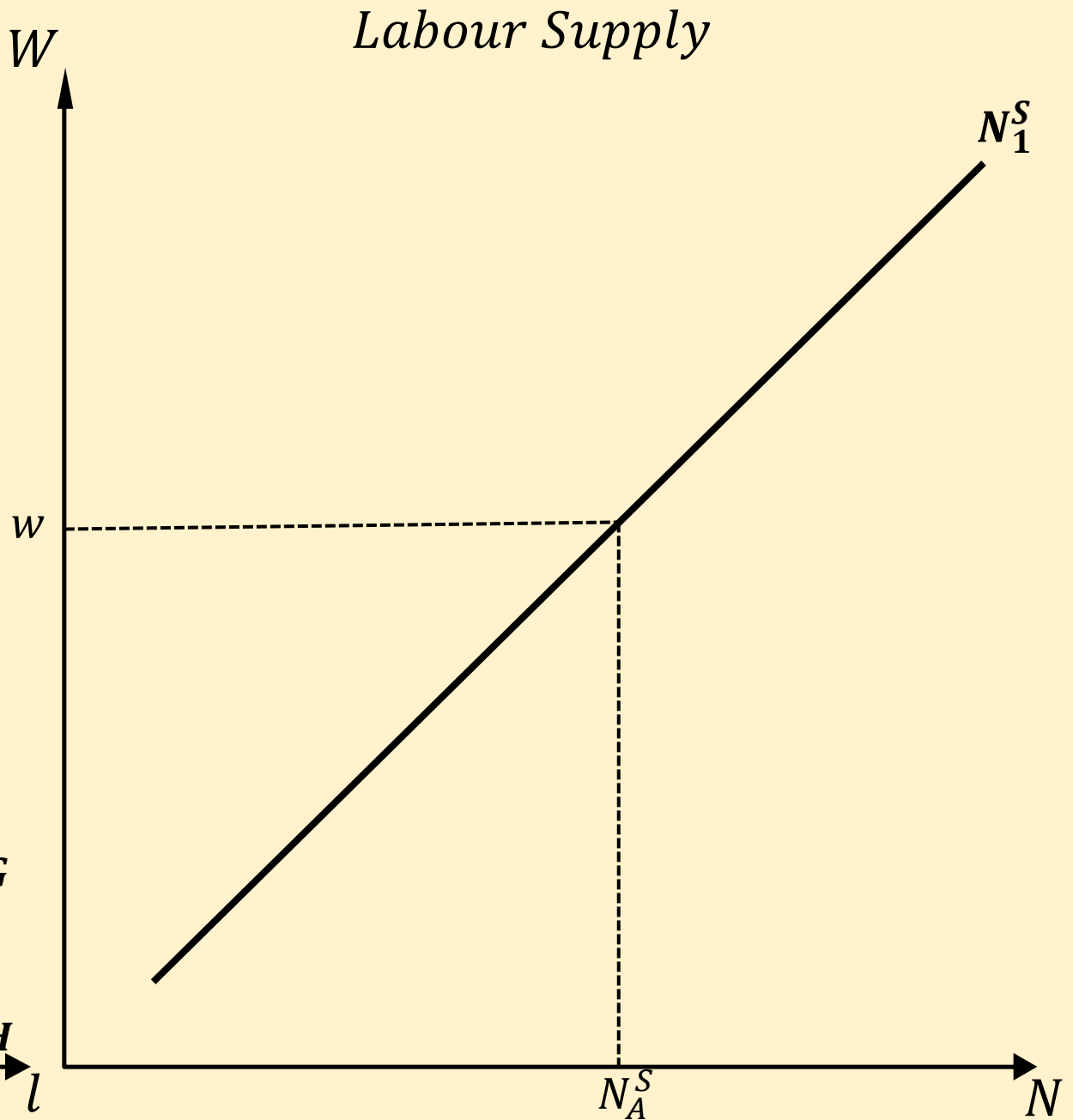

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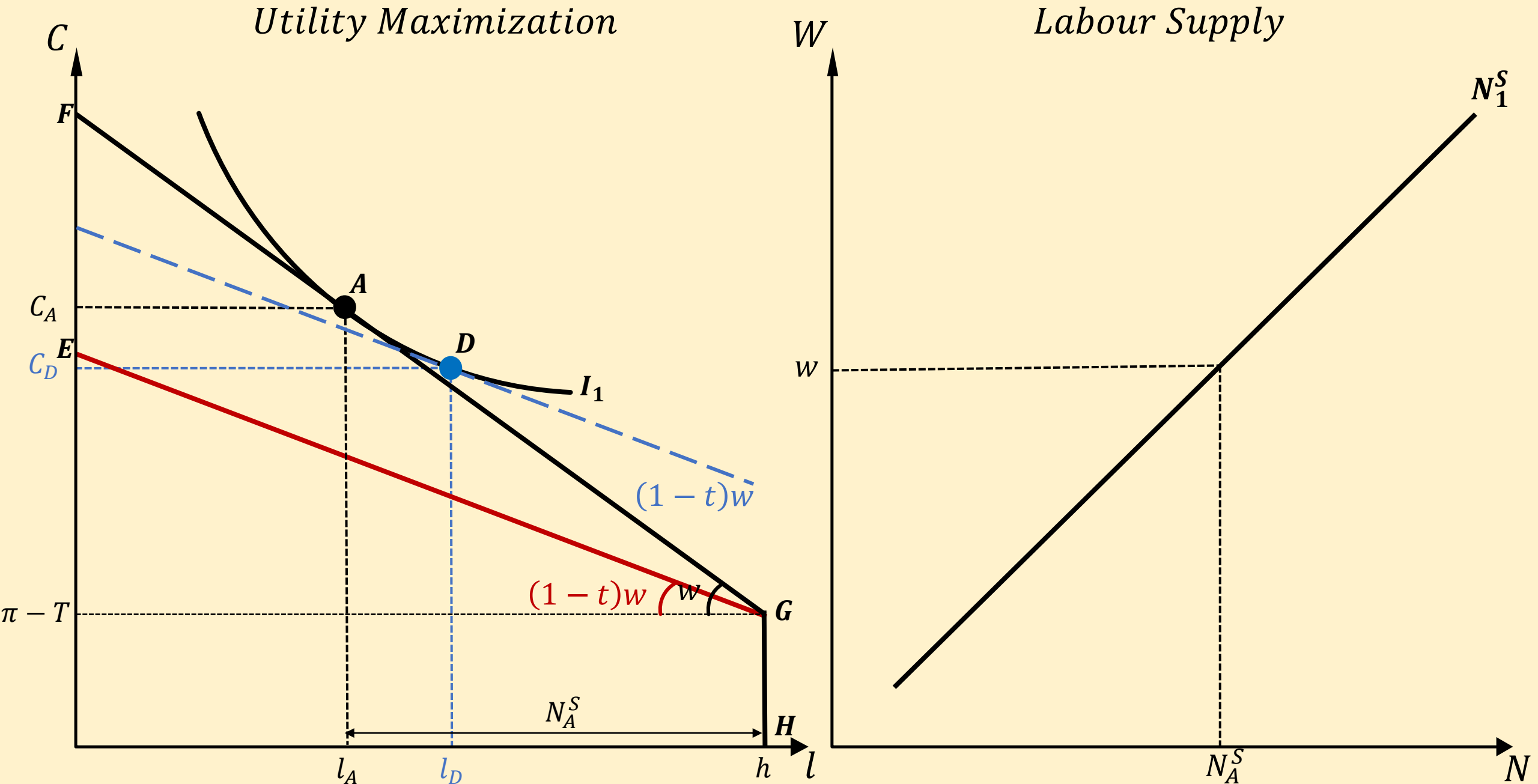

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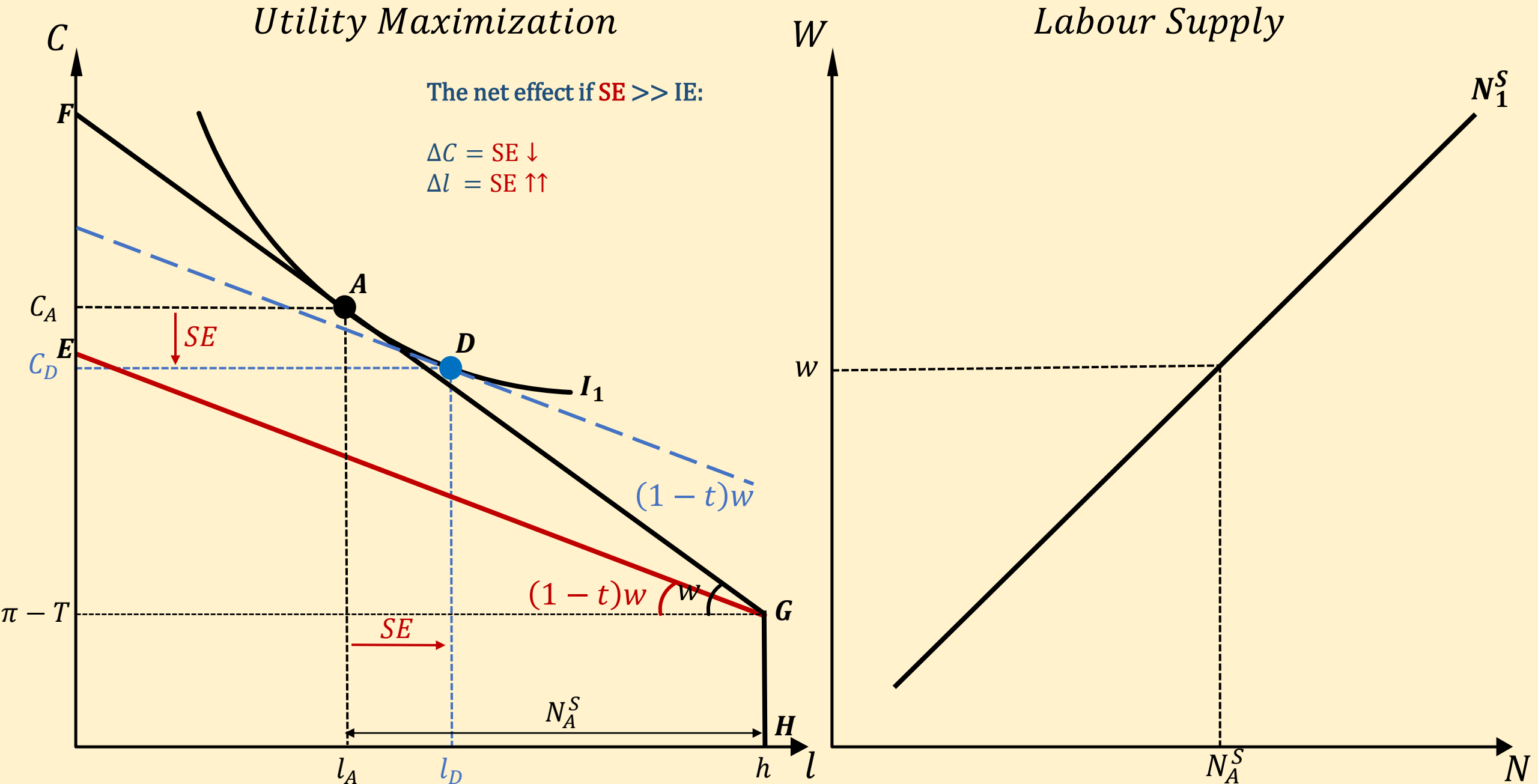

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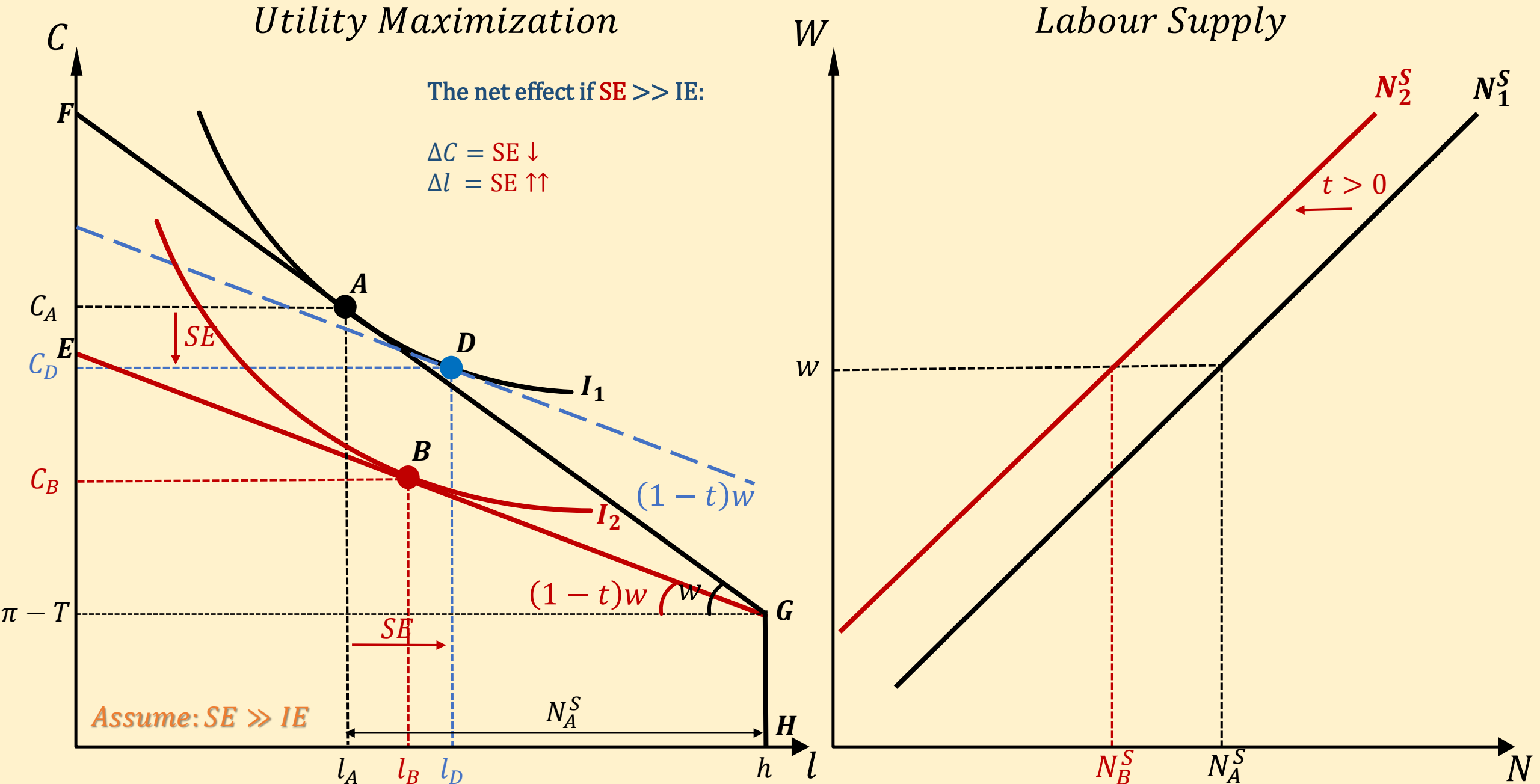

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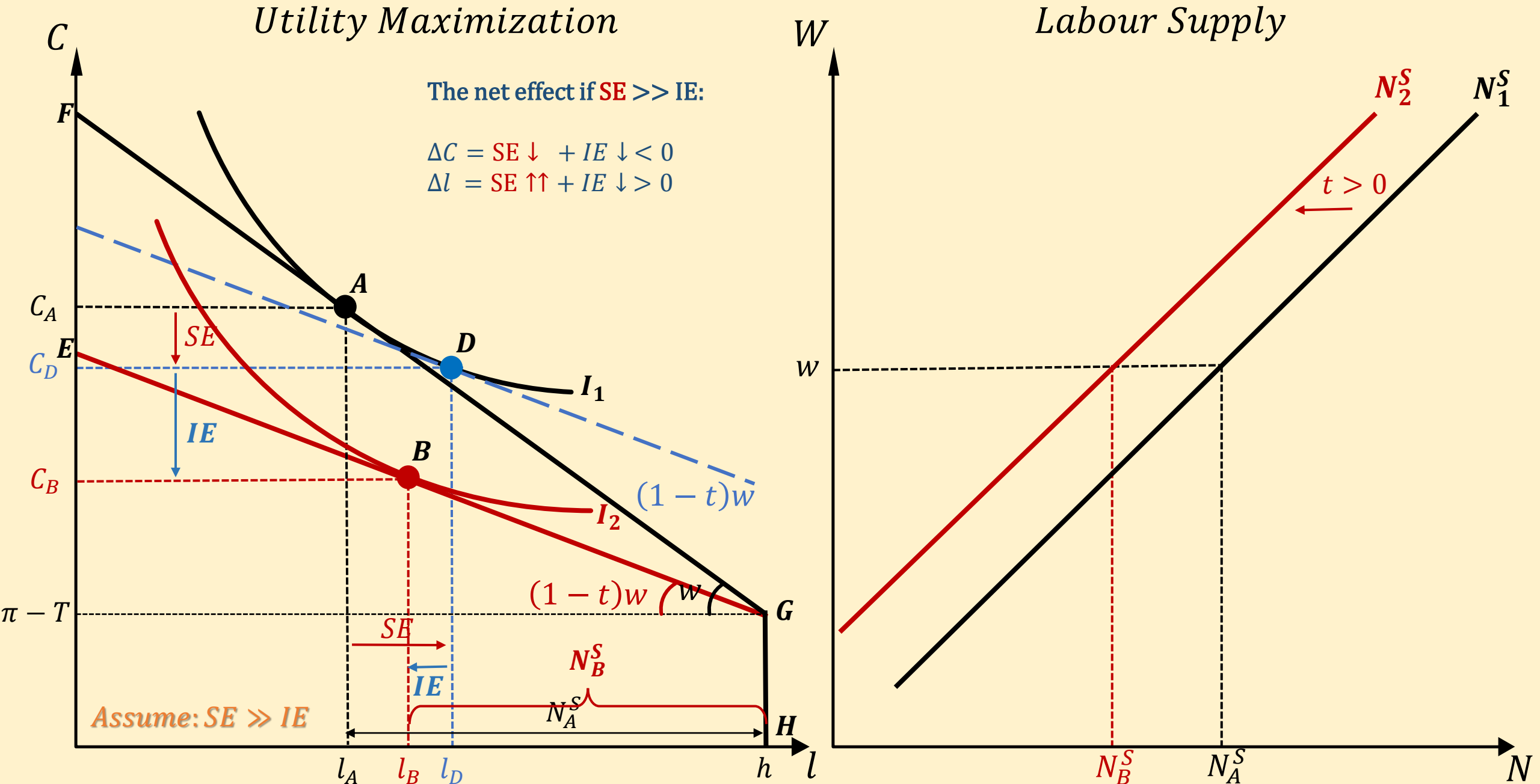

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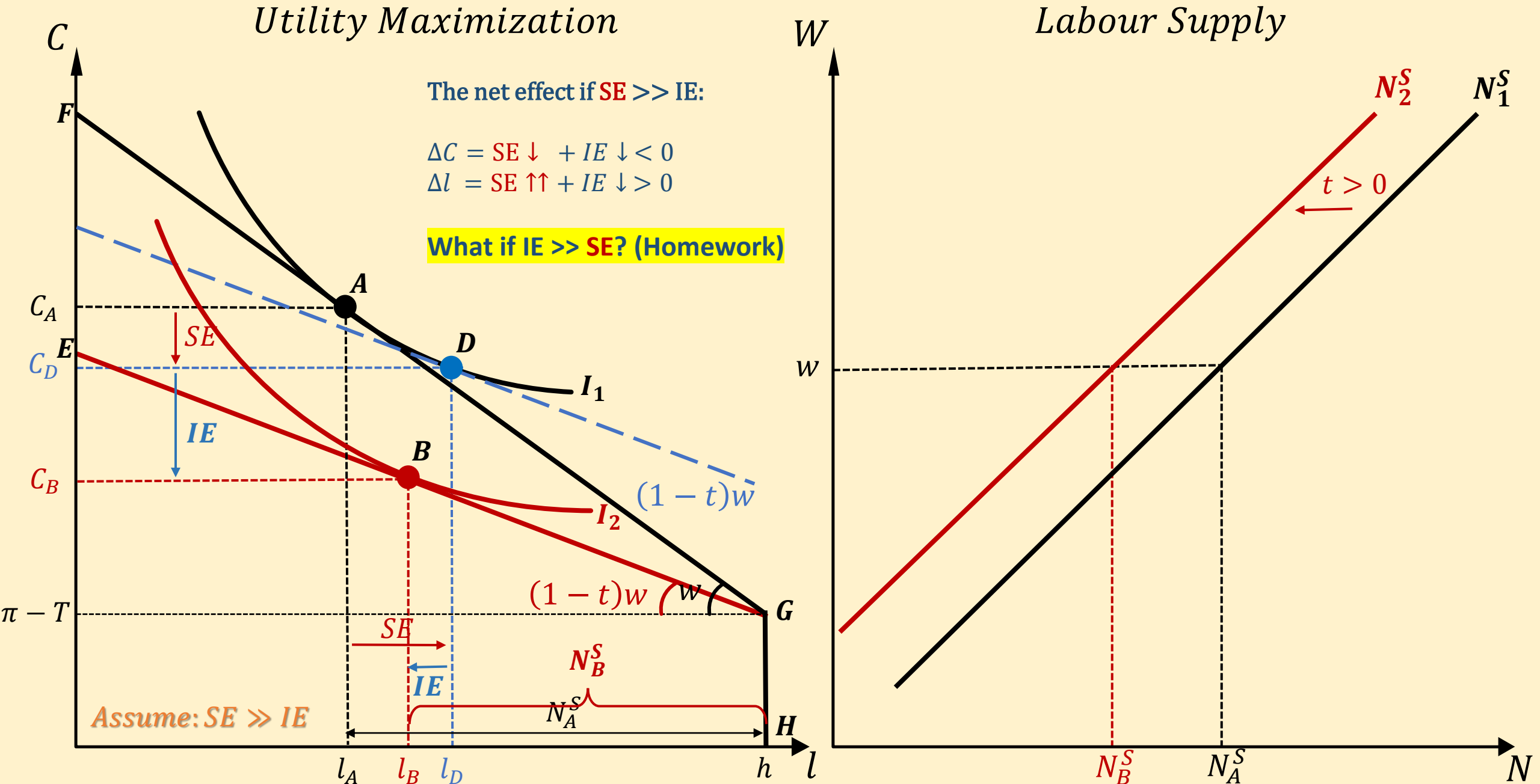

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Q1. What **effects** does the income tax have on consumption and labour supply? Explain your results in terms of income effect (IE)and substitution effect (SE).

In the figure above, the budget constraint for $t = 0$, is FGH. When $t > 0$, the budget constraint is EGH. The slope of the original budget line is $-w$, while the slop of the new budget line is $-(1-t)w$.

Initially, the consumer picks the point A on the original budget line. After the tax t has been imposed, the consumer picks point B.

SE:

The SE of the imposition of the tax is to move the consumer from point A to point D on the original difference curve (i.e., capturing the price effect while holding constant the income effect). The point D is at the tangent point of indifference curve, I_1, with a line segment that is parallel to EG. The pure substitution effect induces the consumer to $\downarrow\ c$ and $\uparrow\ l$ (take more leisure, work less).

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IE:

The tax also makes the consumer worse off, in that the consumer can no longer be on indifference curve, I_1, but must move to the less preferred indifference curve, I_2. This pure income effect moves the consumer to point B, which has less consumption and less leisure than point D because both c and l are normal goods. The net effect of the tax is to reduce consumption, but the direction of the net effect on leisure is ambiguous. Hence, although *consumption must fall, hours worked may rise, fall, or remain the same*.

The figure shows the case in which the SE dominates the IE (SE≫IE). In this case, leisure increases and hours worked fall.

(HOMEWORK: analyse the case when IE≫SE)

Q2. FIRM BEHAVIOUR

Suppose that the government introduce a new corporate tax so a firm has to pay t unit of consumption goods for each unit of output it produces. The total tax amount is:

$$\boldsymbol{tY = tzF(K, N^d)}$$

where t is the tax rate.

Analyze the **effect** of the tax reform on the firm's profit $(\pi)$and demand for labour (N^d).

Q2. FIRM BEHAVIOUR

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We are interested in understanding the behaviour of a representative firm. Given the exogenous z and K and the market price w, the firm's objective is to choose N^D to maximize its profit (π):

$$\pi = TR - TC$$

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$TC = wN^d$

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Thus, before tax:

$$\pi = zF(K, N^d) - wN^d$$

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Before tax:

$$\pi = zF\left(K, N^d\right) - wN^d$$

After tax:

$$\pi = zF\left(K, N^d\right) - wN^d - tzF\left(K, N^d\right)$$
$$\boldsymbol{\pi = (1 - t)zF\left(K, N^d\right) - wN^d}$$

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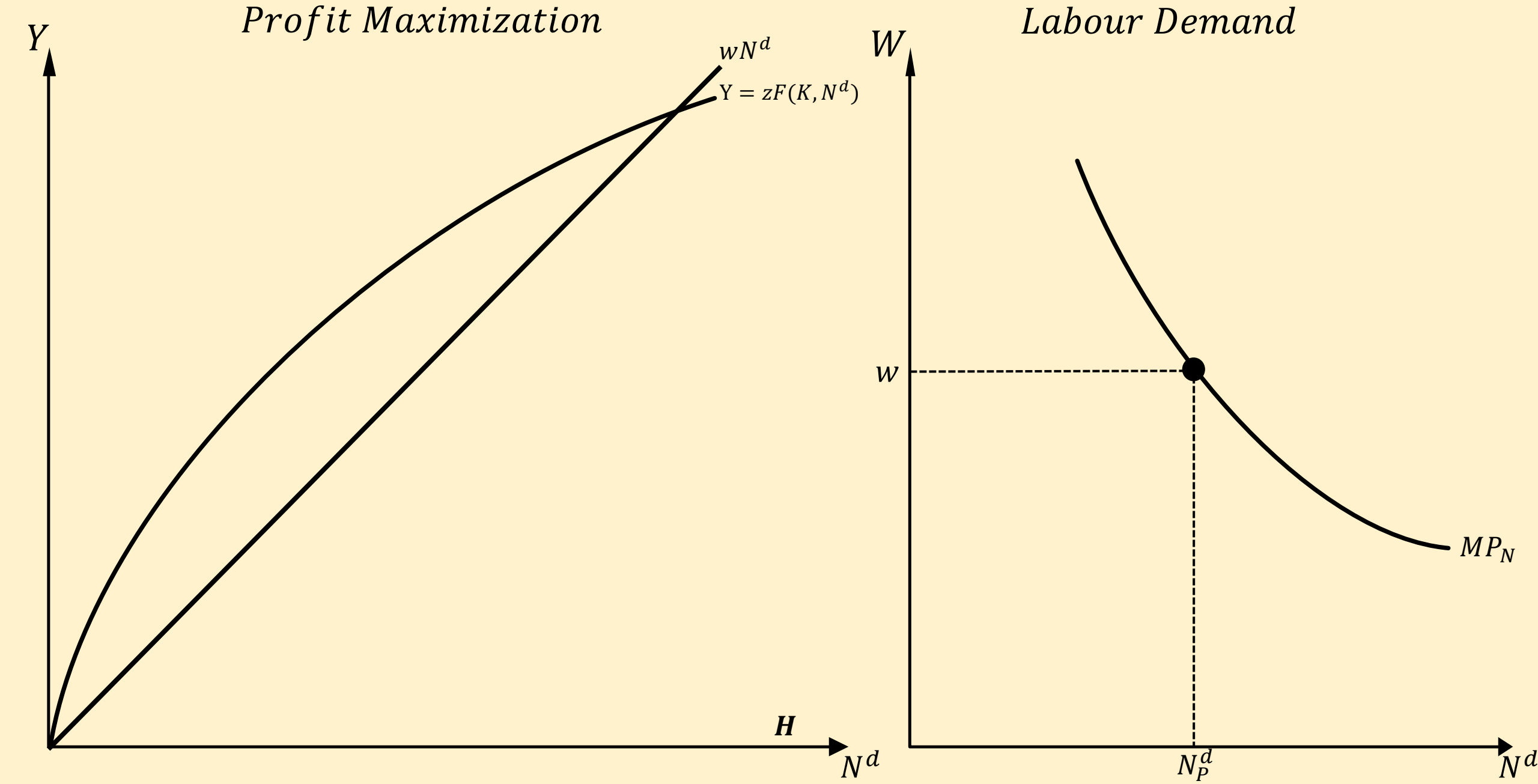

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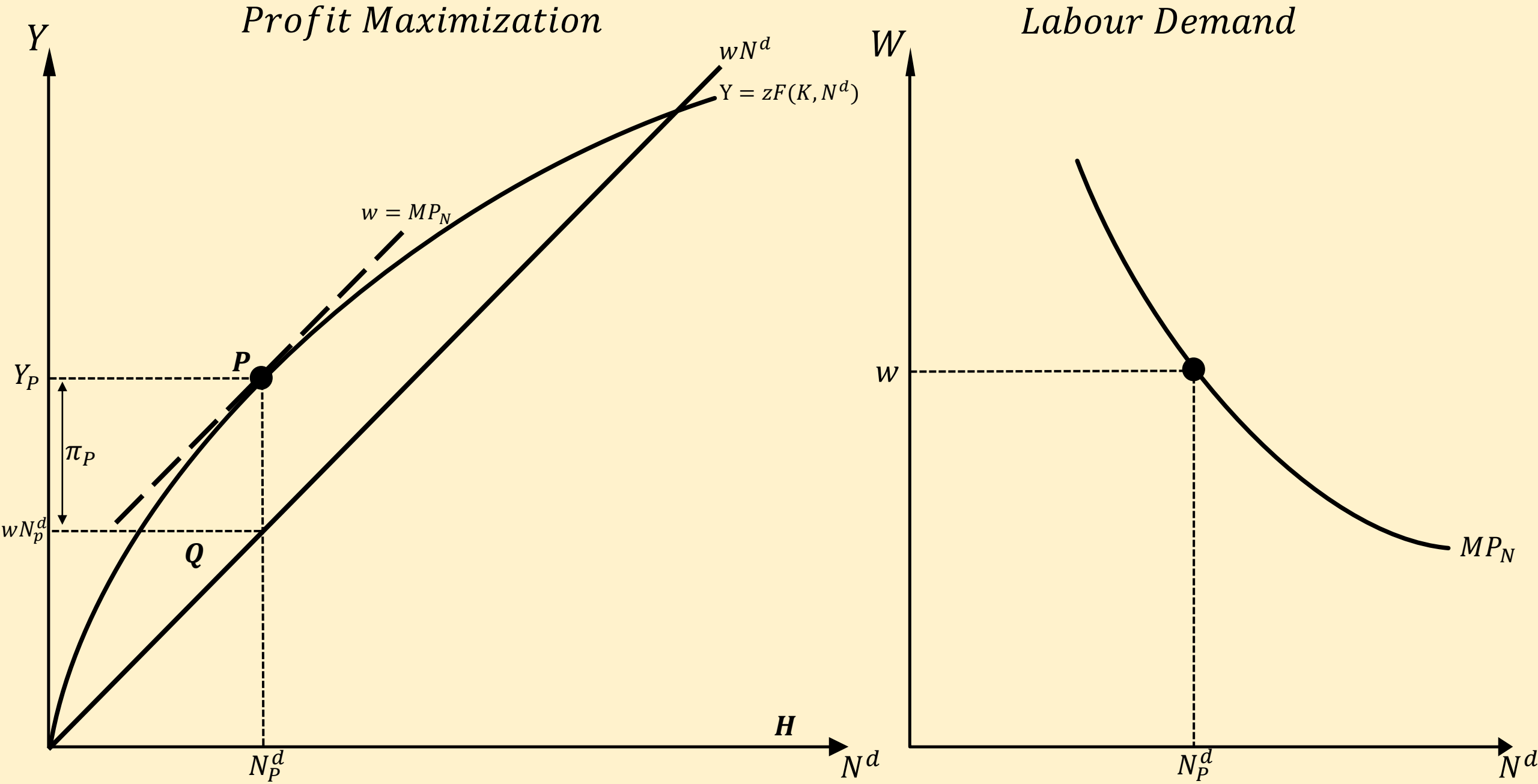

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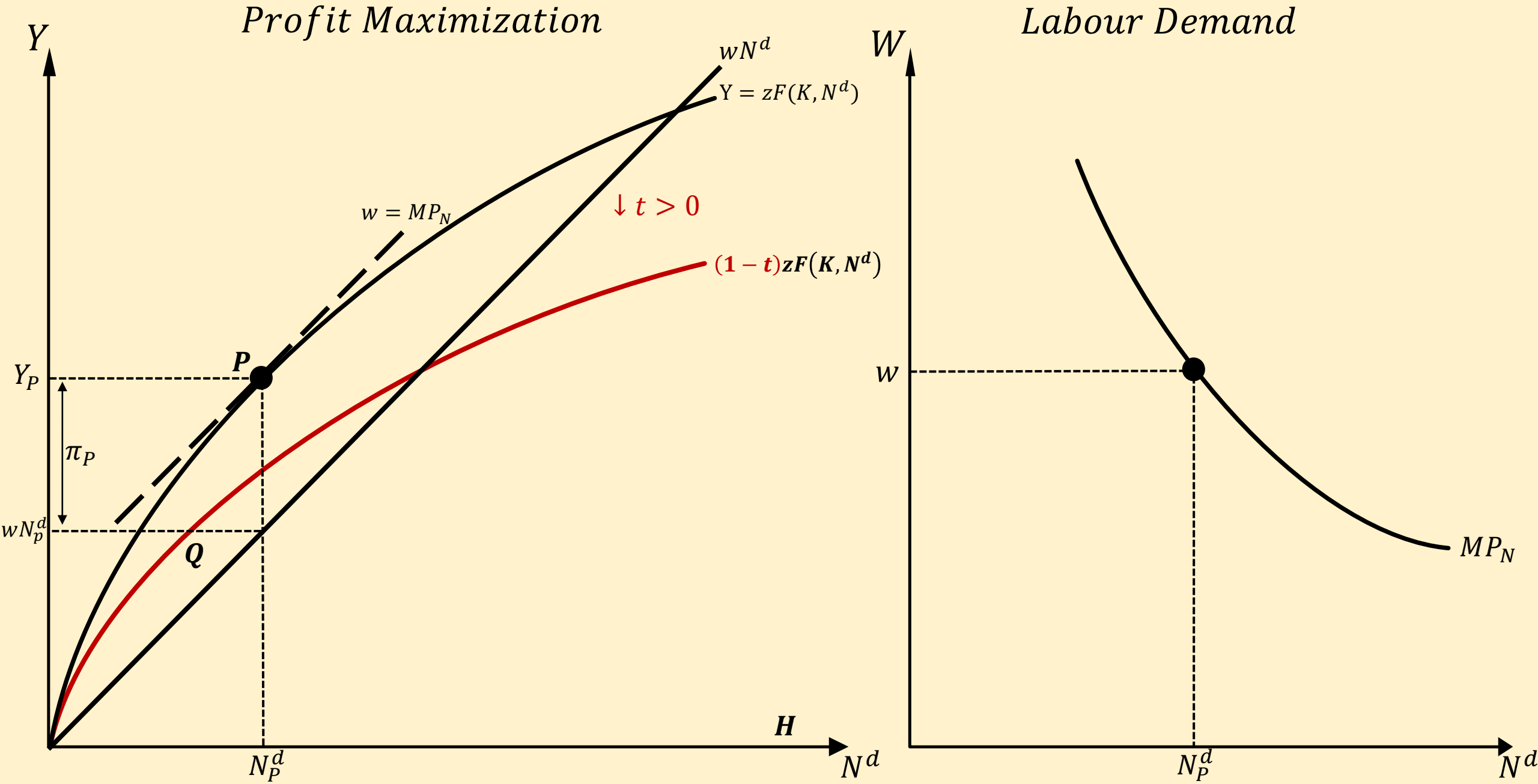

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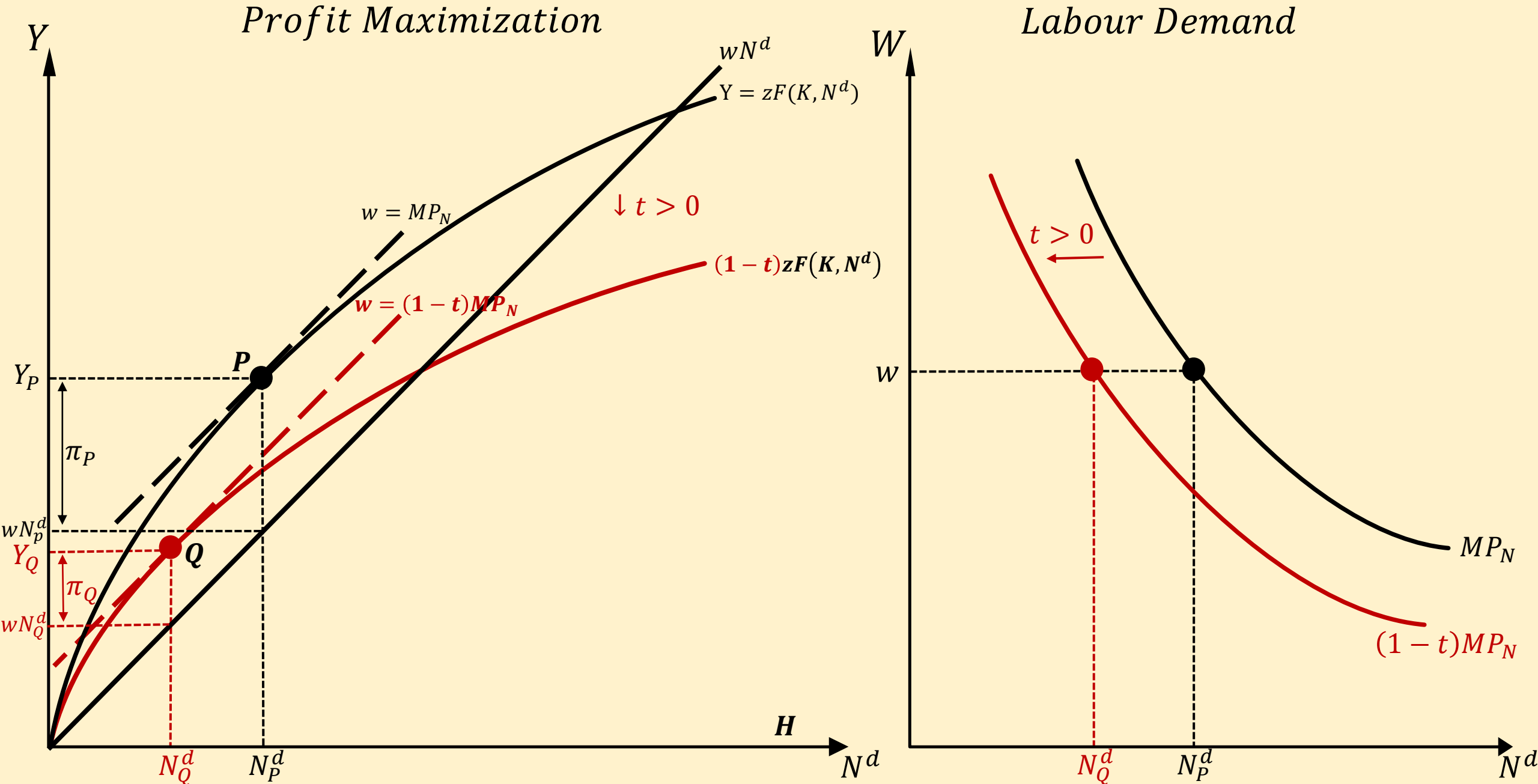

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Q2. Analyze the **effect** of the tax reform on the firm's profit (π)and demand for labour (N^D).

BEFORE TAX:

In the figure, the firm maximizes profits by choosing the quantity of labour where the slope of the revenue function (MP_N) equals the slope of the cost function (w). In other words,

$$MP_N = w$$

The firm's demand for labour curve is the marginal product of labour schedule (MP_N).

Q2. FIRM BEHAVIOUR

Q2. Analyze the **effect** of the tax reform on the firm's profit (π)and demand for labour (N^D).

AFTER TAX:

With a tax proportional to the firm's output, the firm's profits are given by:

$$\pi = zF(K, N^d) - wN^d - tzF(K, N^d) = (1-t)zF(K, N^d) - wN^d$$

Where the after-tax revenue function is $TR = (1-t)zF(K, N^d)$

And, as before, the cost function is $TC = wN^d$

As seen in the figure, the tax acts to shift down the revenue function for the firm and reduces the slope of the revenue function. As before, the firm will maximize profits by choosing the quantity of labour input (N^d) where the slope of the revenue function is equal to the slope of the cost function such that:

$$(1-t)MP_N = w$$

is the new optimization condition.

In other words, the labour demand curve becomes $(1-t)MP_N$ and it shifts down (or, shifts to the left). The tax acts to reduce the after-tax MP_N, and therefore, the firm will hire less labour at any given real wage.

End of Q2

Q3. COMPETITIVE EQUILIBRIUM (CE)

The government introduces a new tax law that requires the representative firm to pay t unit of consumption goods for each unit of output it produces (i.e., carbon tax) such that the total tax amounts to:

$$\boldsymbol{tY = tzF(K, N)}$$

Analyse **the general equilibrium (GE) effects** on output, employment and welfare.

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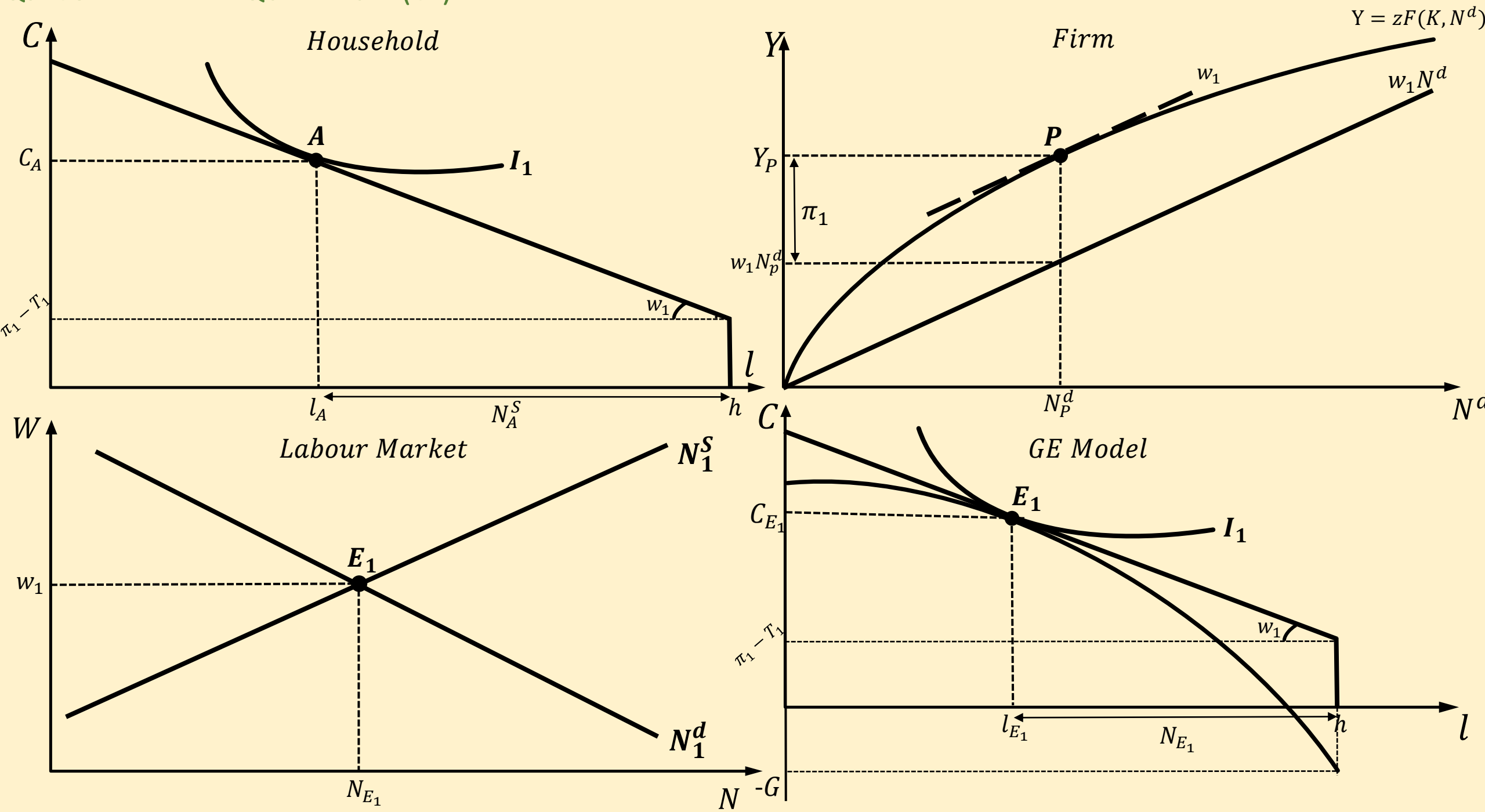

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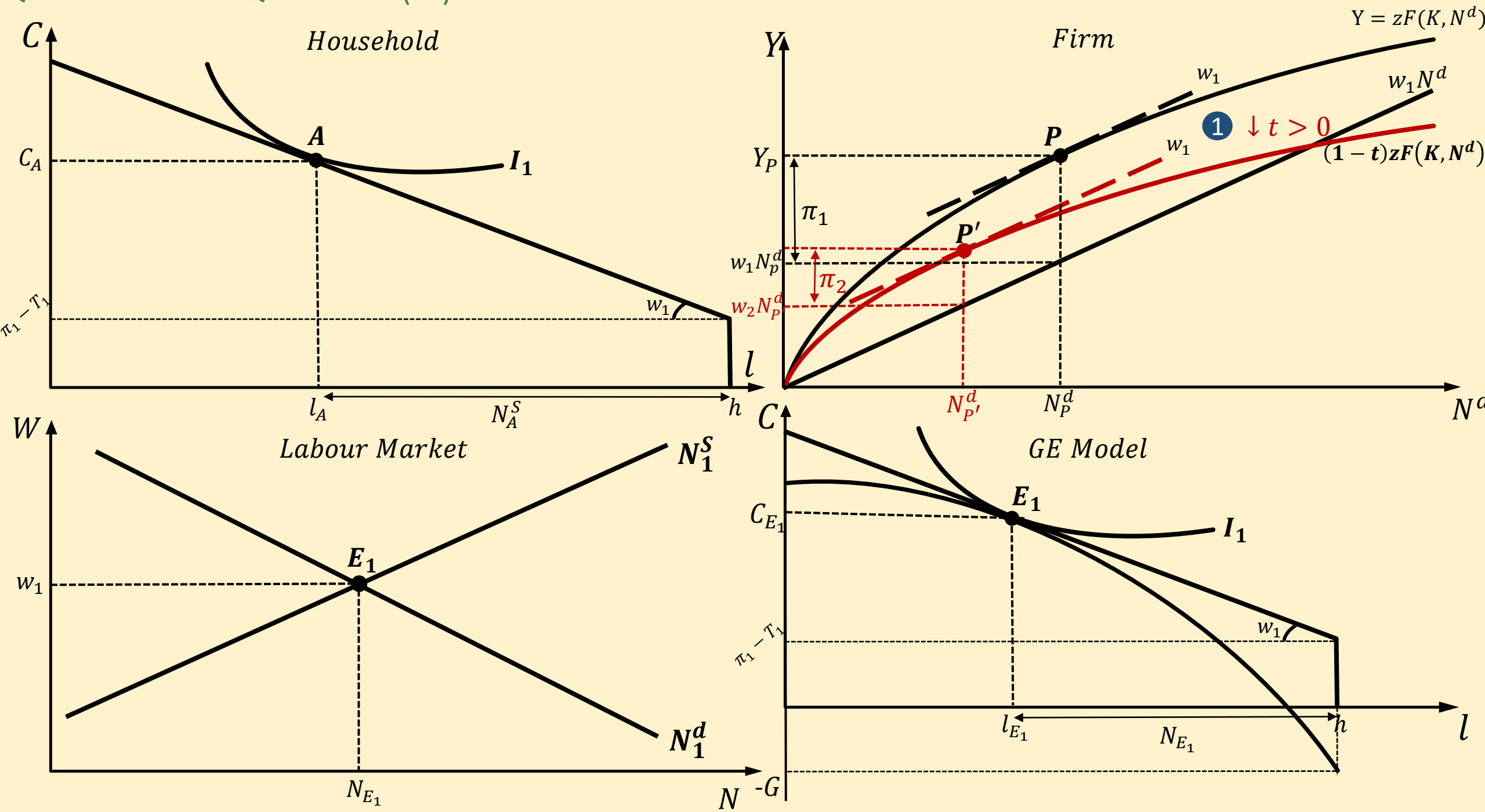

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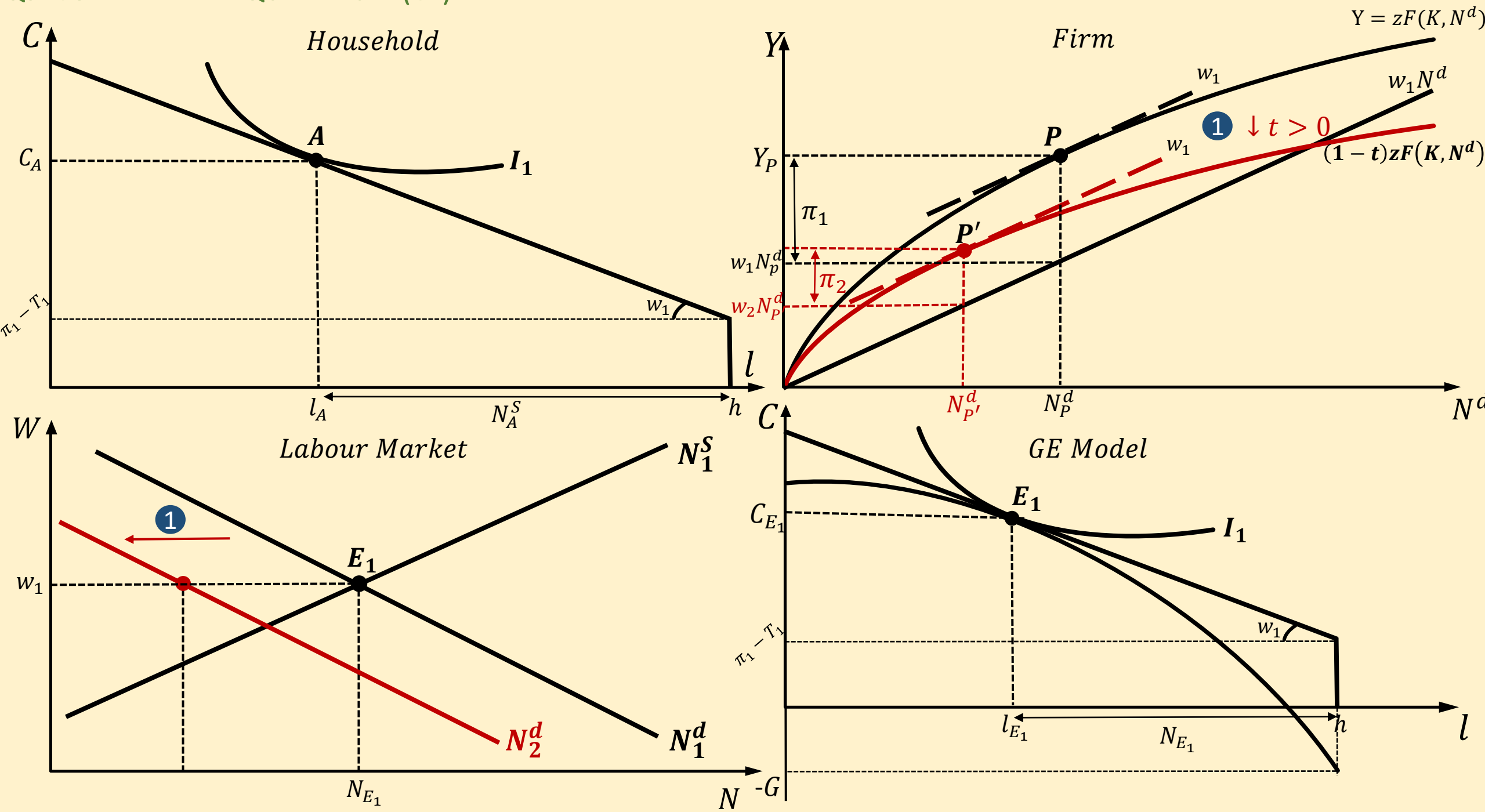

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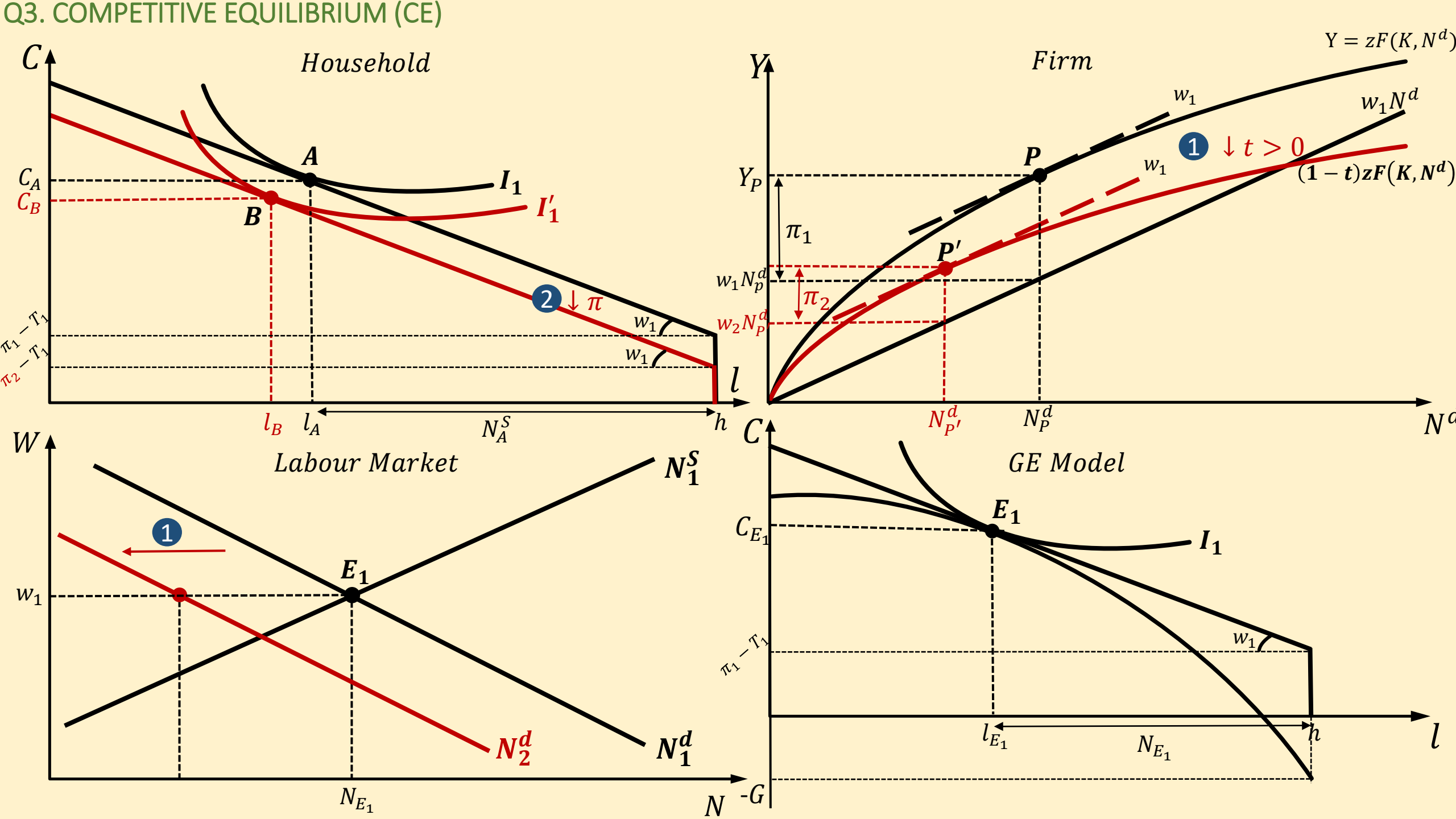

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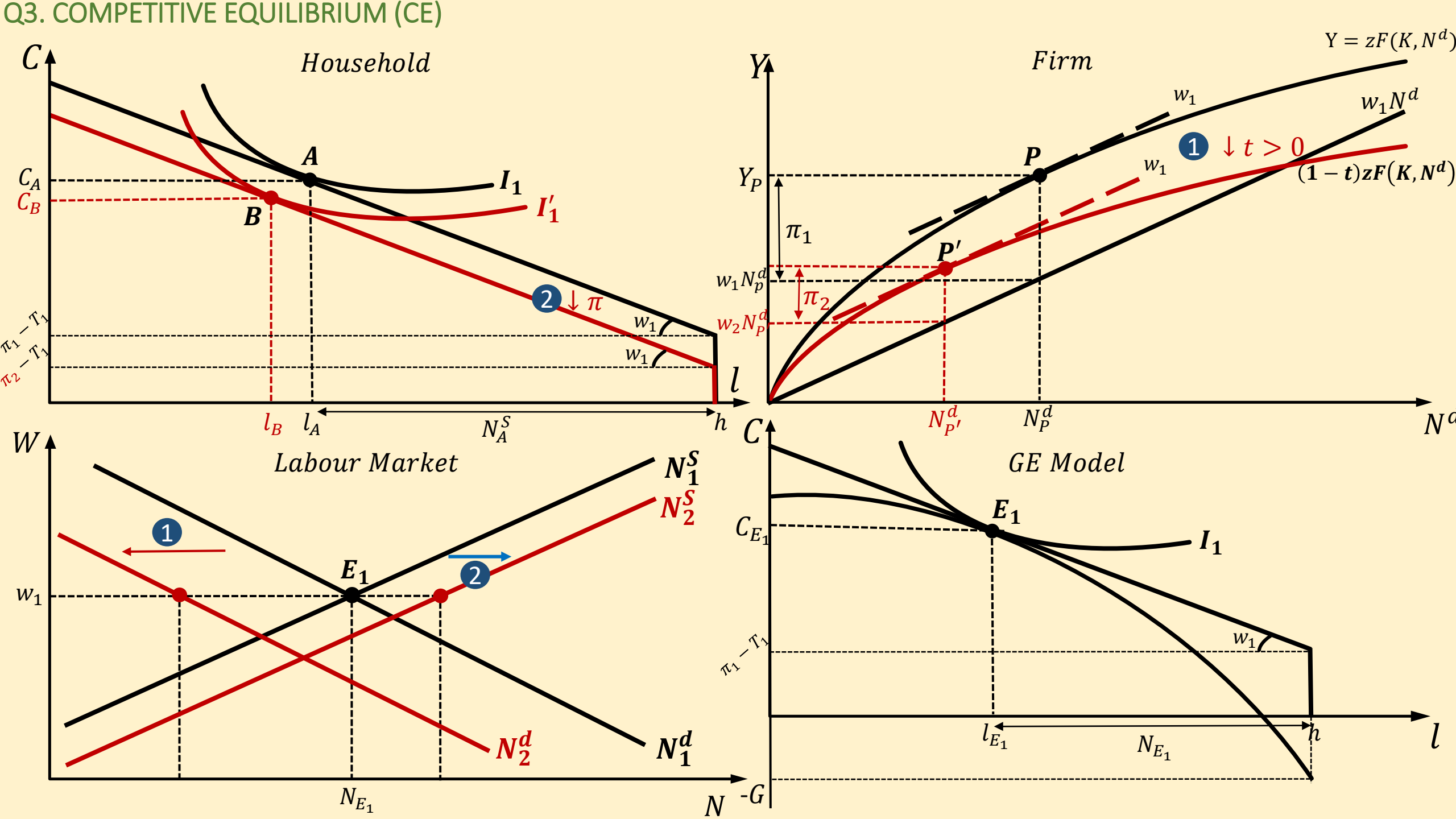

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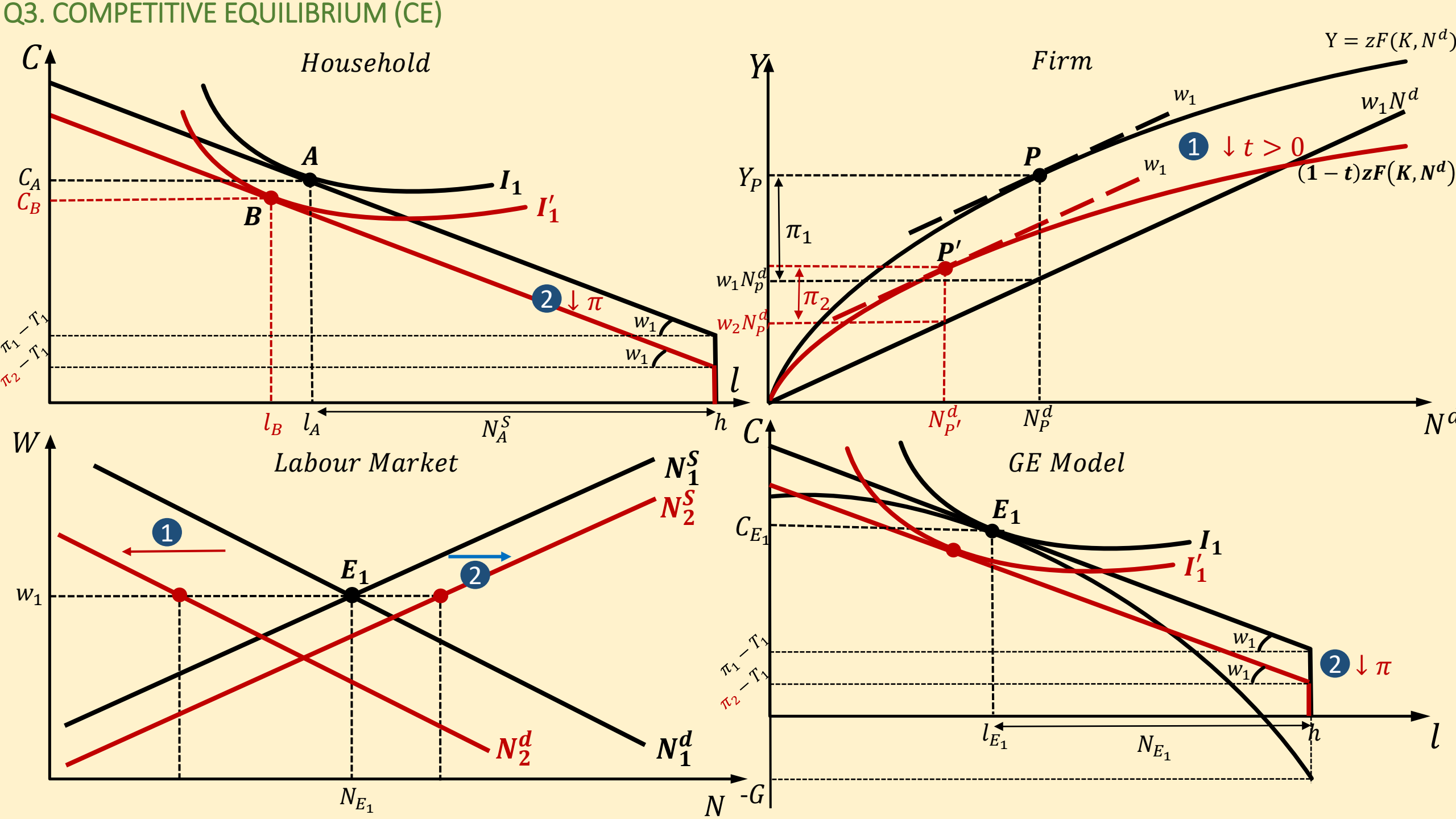

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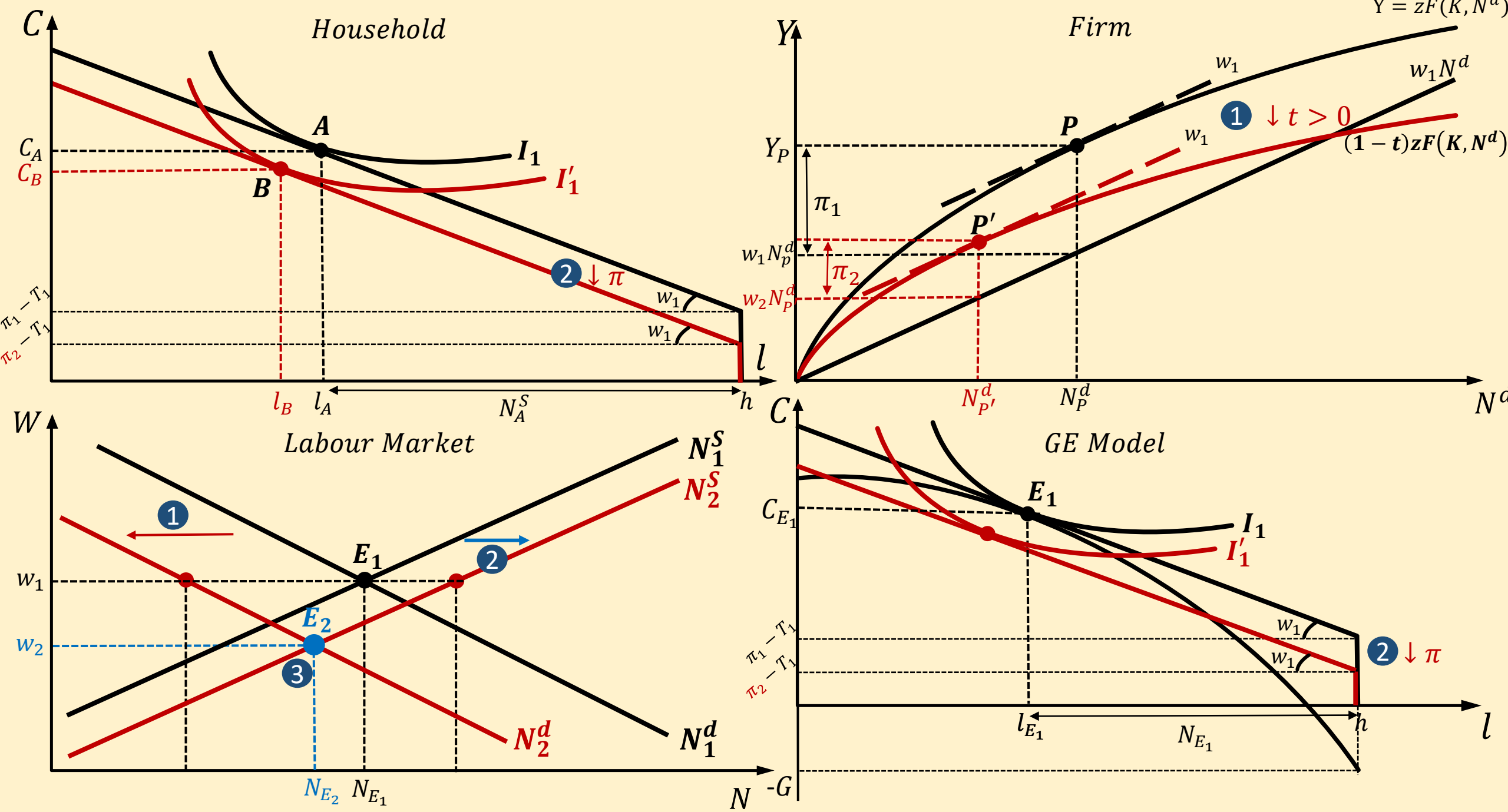

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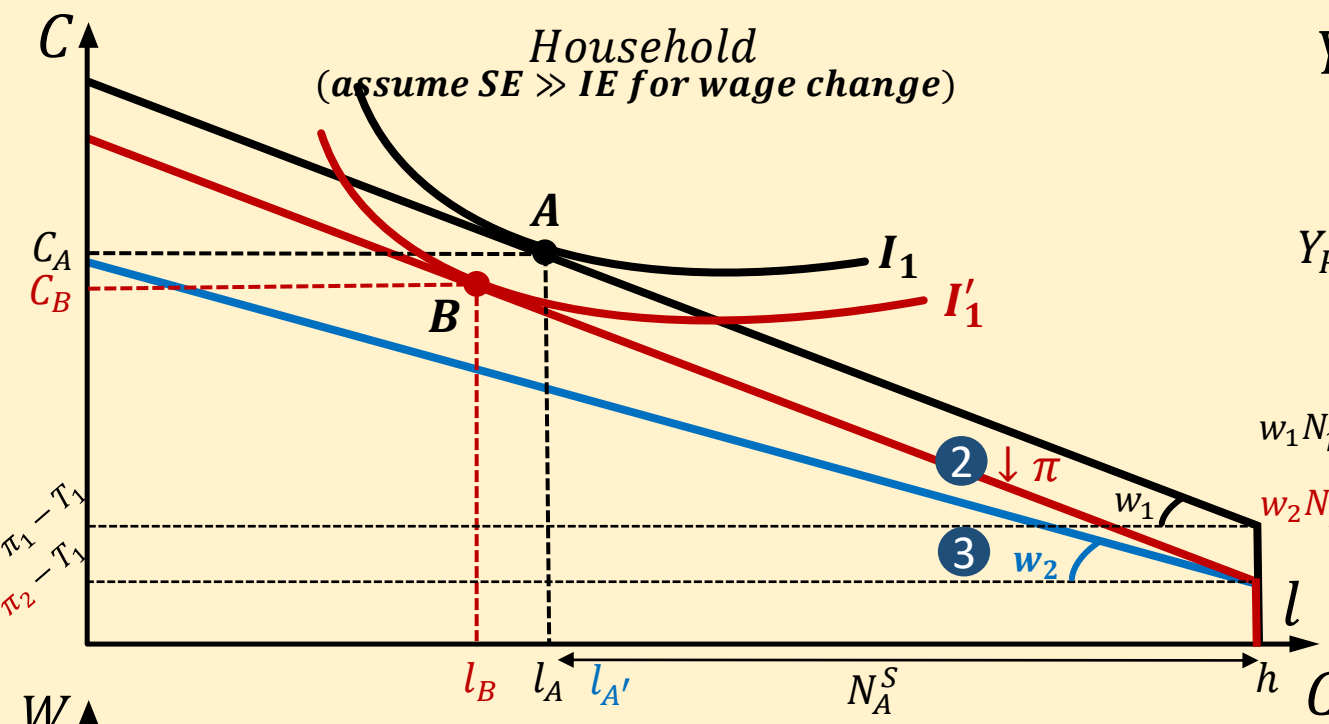

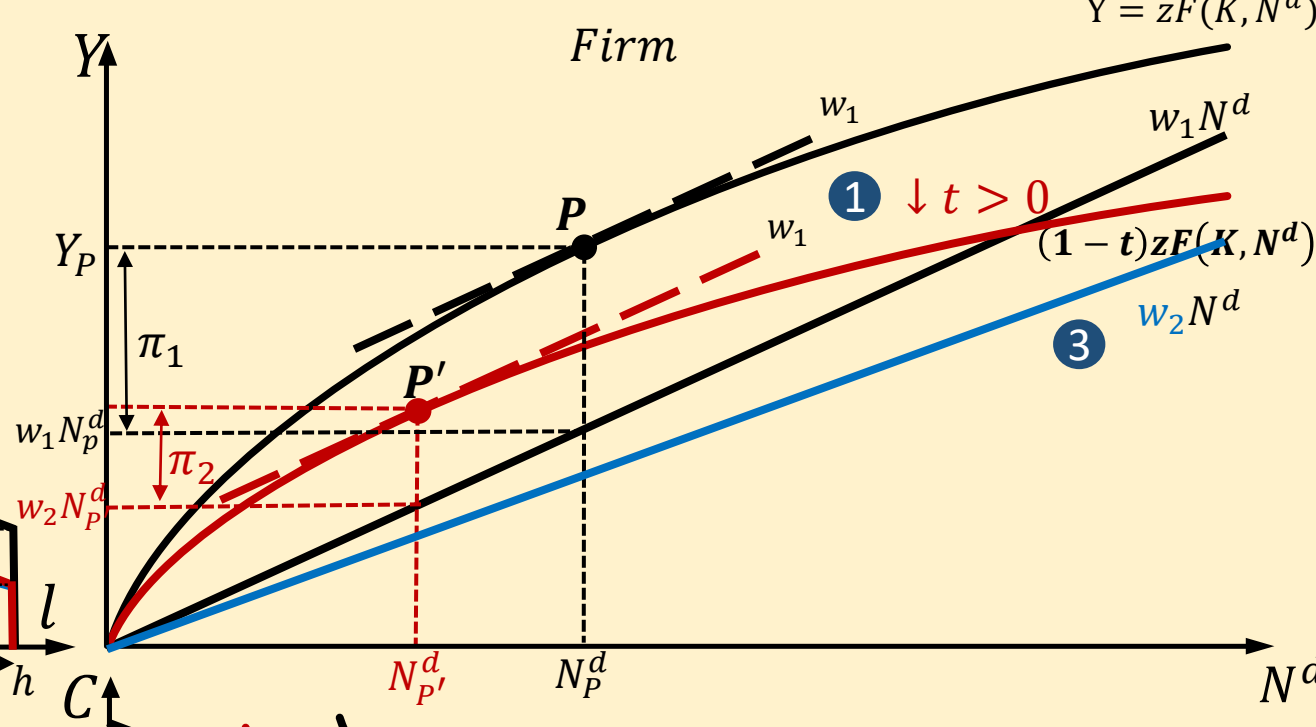

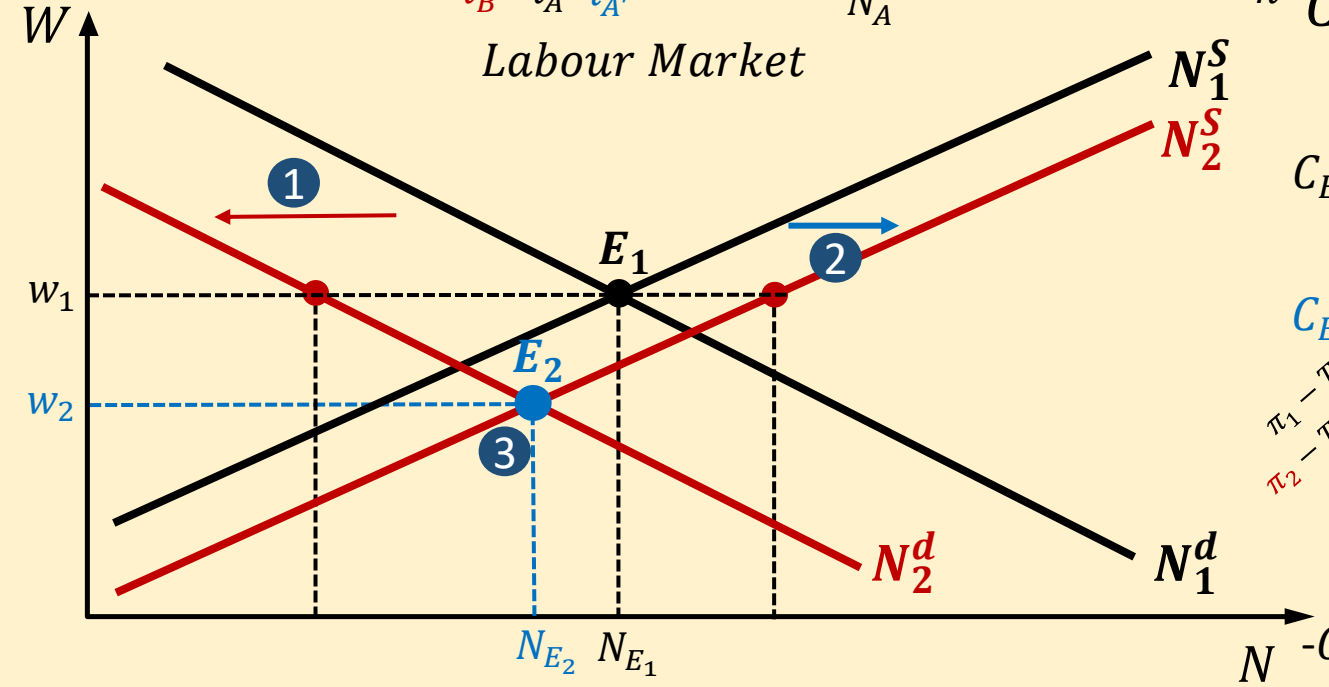

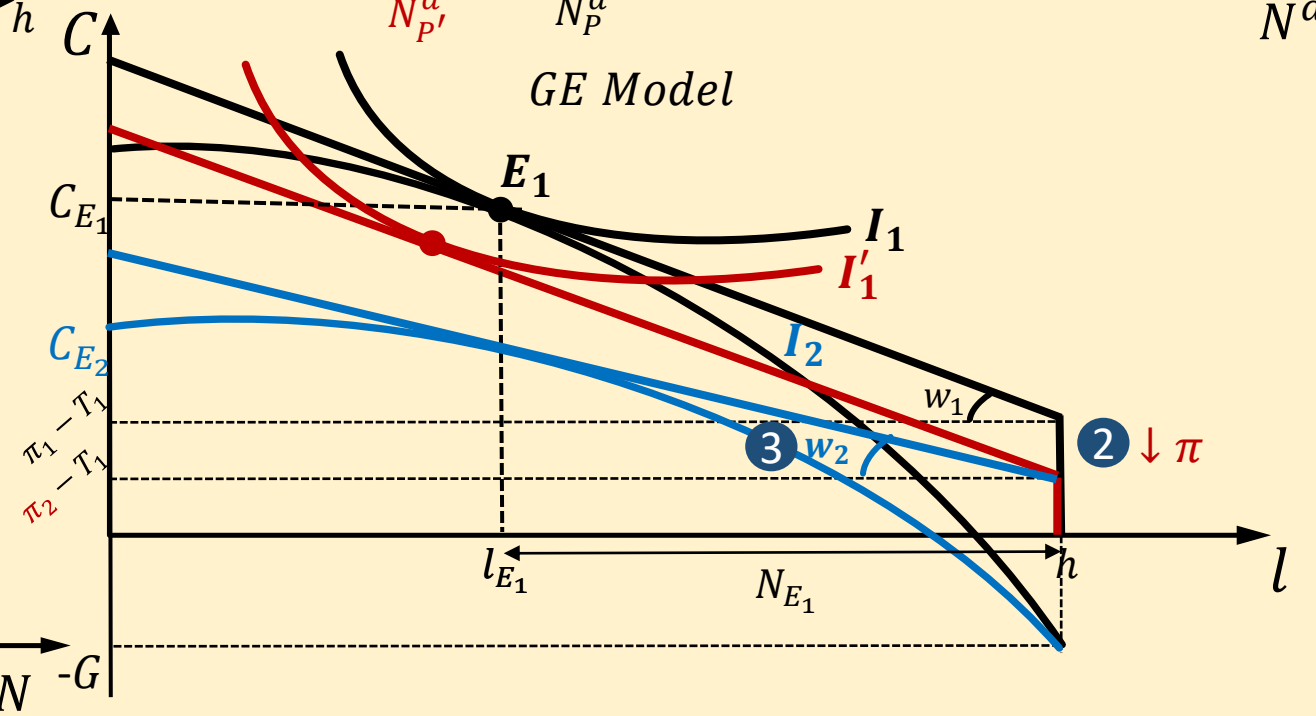

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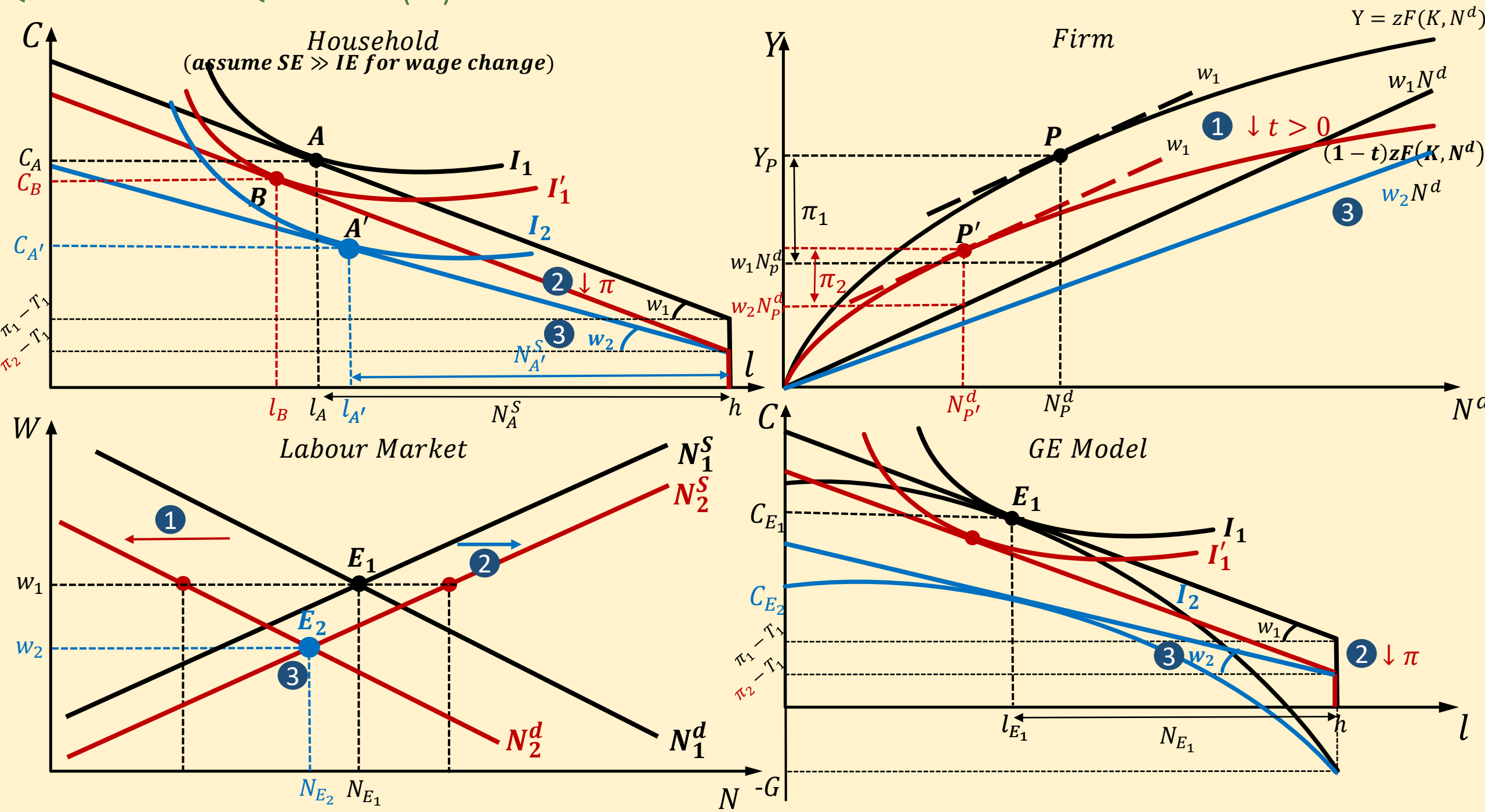

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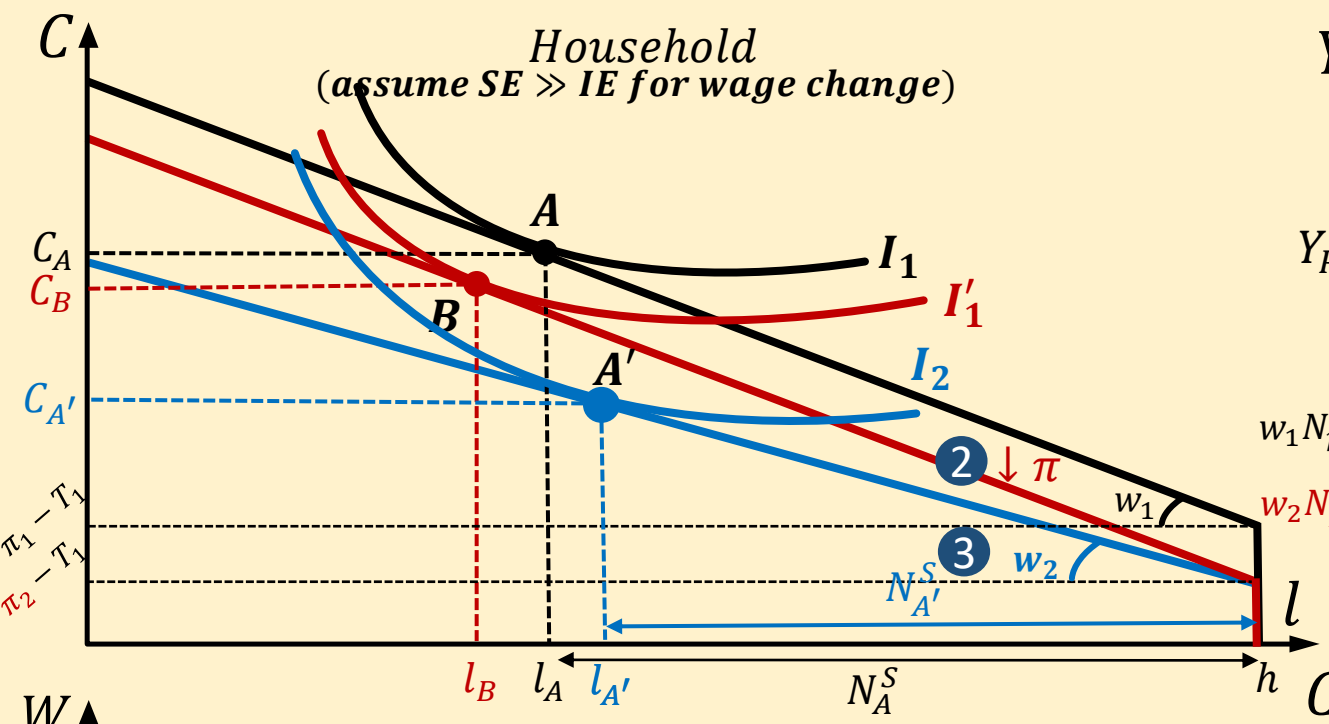

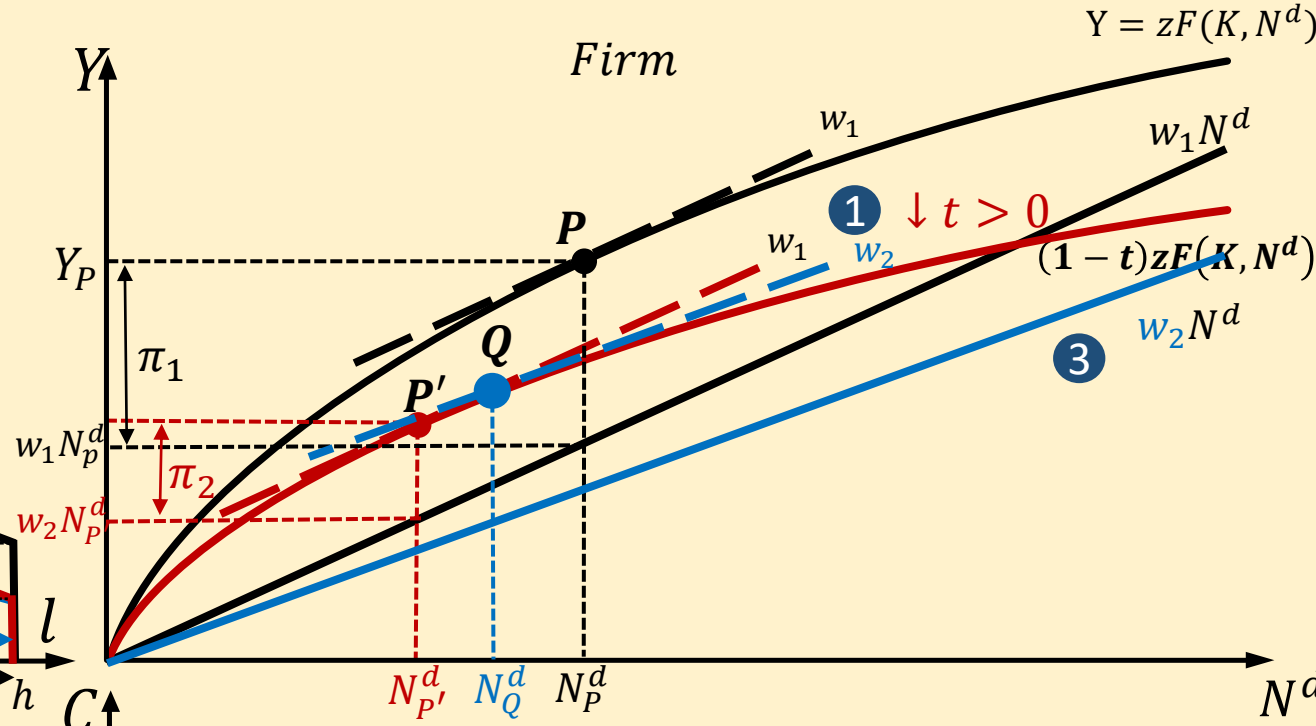

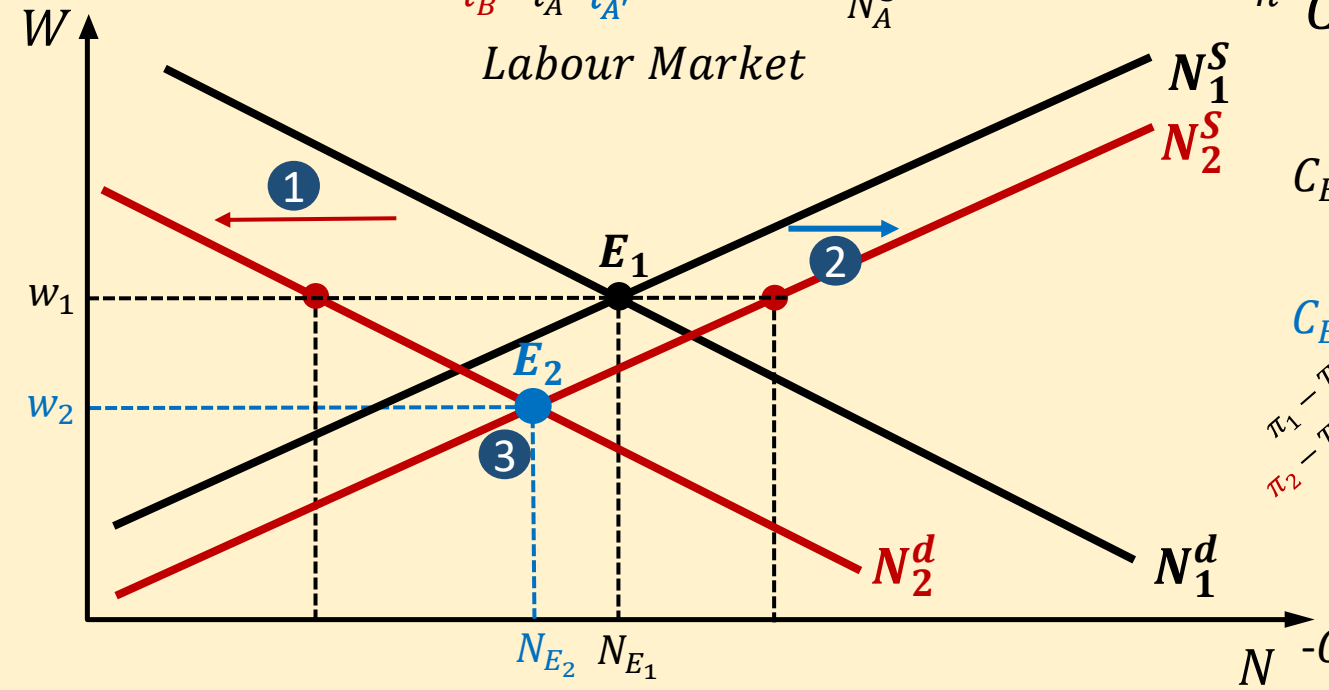

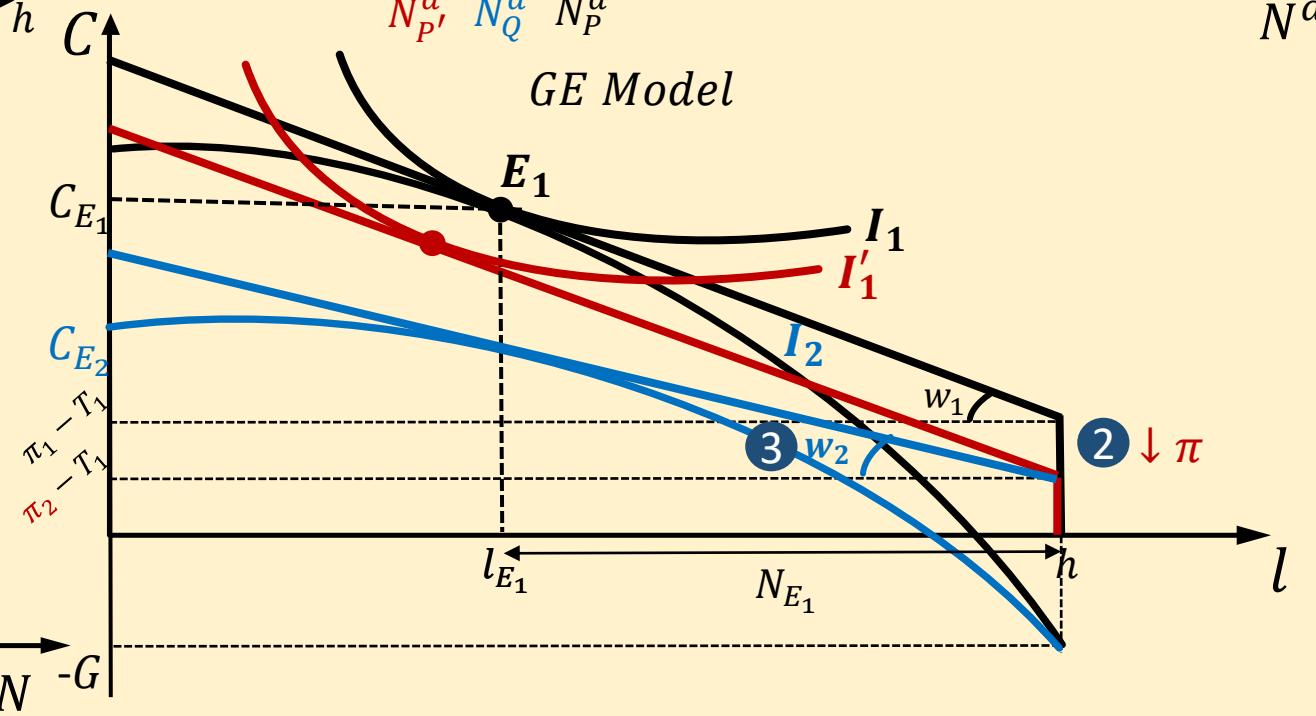

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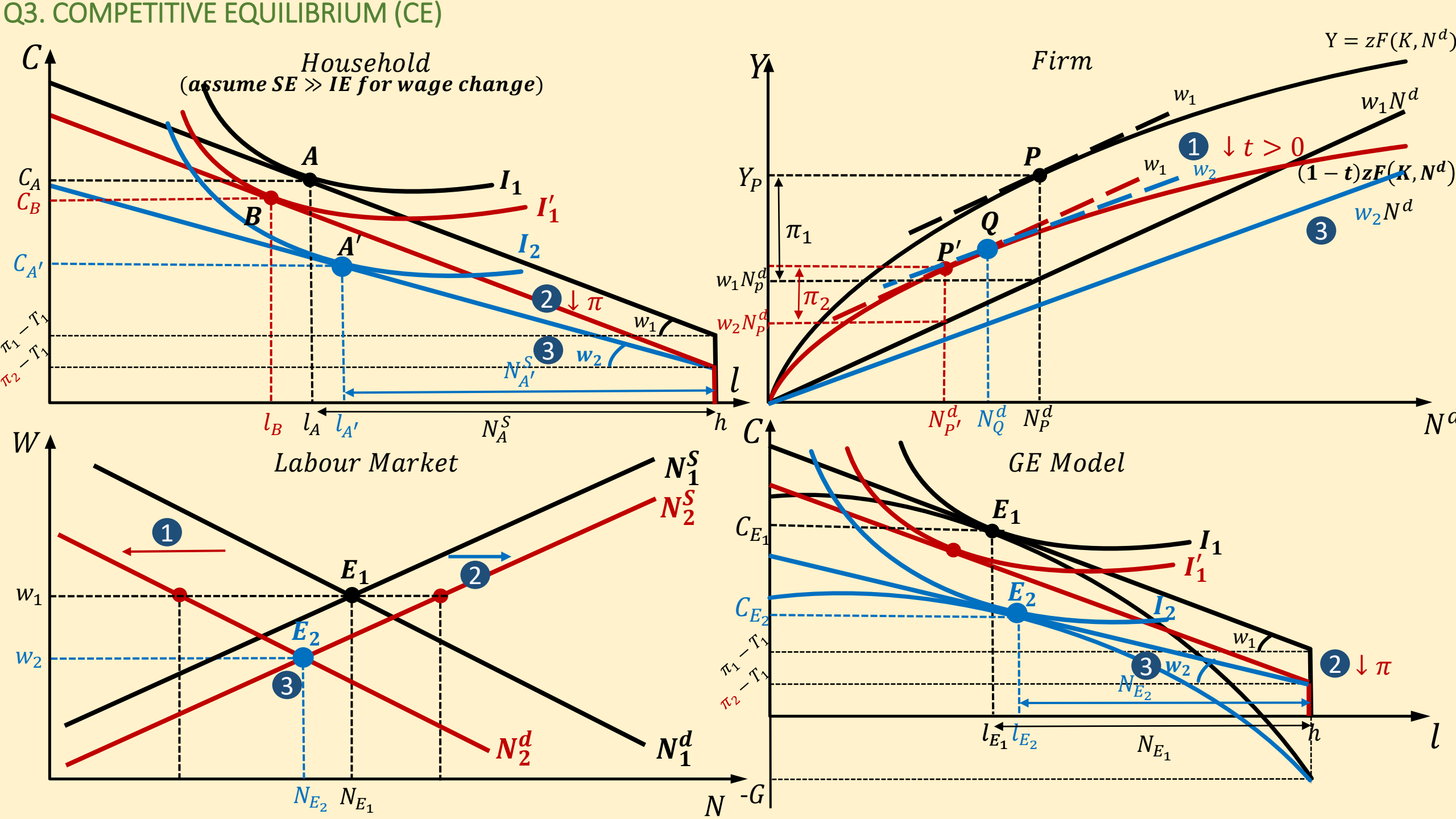

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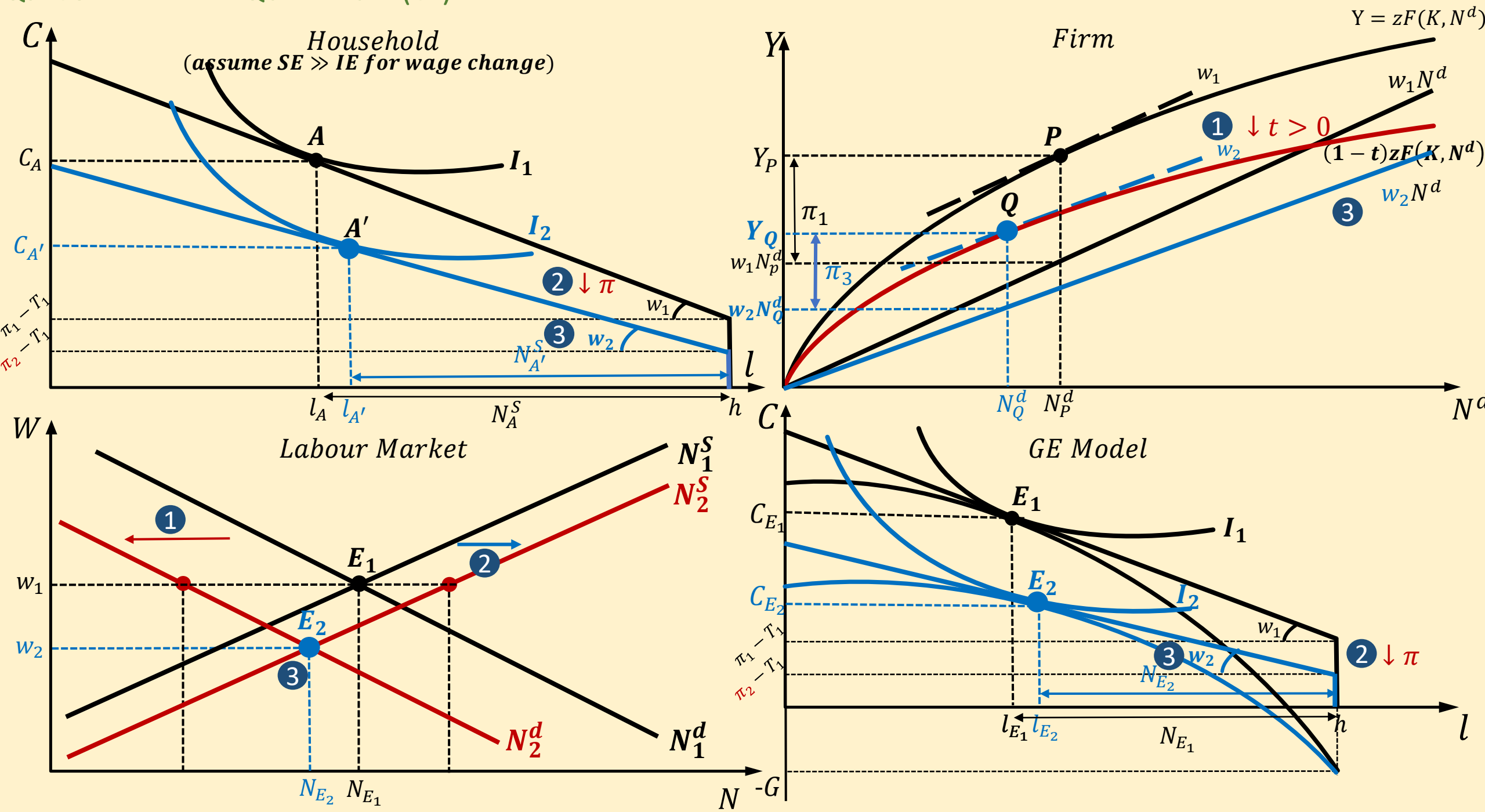

Q3. COMPETITIVE EQUILIBRIUM (CE)

Q3. Analyze **the general equilibrium (GE) effects** of t on output, employment and welfare.

As seen in the figure, the tax acts to shift down the revenue function for the firm and reduces the slope of the revenue function. As before, the firm will maximize profits by choosing N^d where the slope of the revenue function is equal to the slope of the cost function (i.e., $(1-t)MP_N = w$). Subsequently, the labour demand curve has shifted down. The tax acts to reduce the after-tax marginal product of labour, and the firm will hire less labour at any given real wage.

Q3. COMPETITIVE EQUILIBRIUM (CE)

Q3. Analyze **the general equilibrium (GE) effects** of t on output, employment and welfare.

The introduction of the new tax law is similar to a negative TFP shock ($z\ shock$), which basically creates three main effects:

1. $t > 0 \rightarrow\ Y = (1-t)zF(K,N) \rightarrow\ Y \downarrow \rightarrow (i).\pi \downarrow, and\ (ii).N^d\ shifts\ to\ the\ left$;
2. $\pi \downarrow \rightarrow negative\ income\ effect \rightarrow\ N^S\ shifts\ to\ the\ right$. We assume that the decrease in dividend income (π) is small so that the shift of the labour supply curve (N^S) is relatively small.
3. $1\ and\ 2\ result\ in\ excess\ labour\ supply\ in\ the\ labour\ market \rightarrow downward\ pressure\ w \downarrow \rightarrow (i).N^S \downarrow, (ii).N^d \uparrow: move\ along\ N^S\ and\ N^d\ curves \rightarrow\ a\ new\ equilibrium\ E_2\ with\ w_2 < w_1\ and\ N_{E_1} < N_{E_2}$.

In conclusion, the GE adjustment brings the economy to a new CE that has lower output, employment and welfare. This process is illustrated in the previous figure.

$End\ of\ Q3$