Theories of Growth & Development

EC 390 - Development Economics

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2025

Goals

- Look at economic **theories/models** to see what they can say about:
  - What can be done to improve a country's economic growth
  - What changes to expect as a country develops

- We will begin with **growth models** → Factors that influence **economic growth**

Harrod-Domar Growth Model

Model 01 - Harrod-Domar

Savings drive growth

- The **more a country saves**, the more it can **invest in capital**
- To produce output, the only thing we need is **capital**
  - We ignore labor

- Let's start with the **model assumptions**

Harrod-Domar Assumptions

1. **Net savings** (S) is a fixed proportion of **national income** (Y)
2. A fixed amount of **Capital** (K) is need to produce output
3. All new **Investments** (I) is used to increase the **Capital Stock** (K)
4. The **savings-investment** market **clears**

Harrod-Domar Assumptions

1. **Net savings** (S) is a fixed proportion of **national income** (Y)

$$S = sY$$

$$0 \leq s \leq 1$$

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Harrod-Domar Assumptions

1. **Net savings** (S) is a fixed proportion of **national income** (Y)
2. A fixed amount of **Capital** (K) is need to produce output

- **Capital** is a fixed proportion of output where c is a **capital-output ratio**

$$K = cY$$

$$\Rightarrow c = \frac{K}{Y}$$

$$\Rightarrow \Delta K = c\Delta Y$$

3. All new **Investments** (I) is used to increase the **Capital Stock** (K)

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$$I = \Delta K$$

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4. The **savings-investment** market **clears**

- All savings are used as investment

$$S = I$$

Harrod-Domar Growth Model

We are after the **Growth Rate of Income (or production)**

$$\frac{\Delta Y}{Y}$$

- There are only **4 equations**
- **Algebra** is easy once you know how and where you are going

Harrod-Domar Growth Model

Our 4 equations

1. $S = sY$
2. $S = I$
3. $I = \Delta K$
4. $\Delta K = c\Delta Y$

Show that

$$sY = c\Delta Y$$

$$sY = S \Rightarrow sY = I \Rightarrow sY = \Delta K \Rightarrow sY = c\Delta Y$$

Harrod-Domar: Growth Rate of Output

Recall we want to find the **Growth Rate of Income** $\frac{\Delta Y}{Y}$

We can rearrange $sY = c\Delta Y$ to get it

$$\frac{\Delta Y}{Y} = \frac{s}{c}$$

- This states that the **Rate of Growth of GDP** is determined by the **net national savings ratio** (s) and the **national capital-output ratio** (c), at the same time
  - **Positively** related to the savings ratio
  - **Negatively** related to the economy's capital-output ratio

Harrod-Domar: Growth Rate of Output

$$\frac{\Delta Y}{Y} = \frac{s}{c}$$

Let's break it down a bit

$\frac{1}{c}$ measures the **efficiency of capital use**

- The lower the value of c (the more efficient) that an economy runs at, the greater the output that can be gained from additional investment
  - A higher c means less output of Y
  - If c increases, then the **growth rate decreases**

Harrod-Domar: Growth Rate of Output

$$\frac{\Delta Y}{Y} = \frac{s}{c}$$

s is the economy's **saving rate**, which influences the level of investment

- A higher s implies a higher investment level
- If s increases, then the **growth rate increases**

Harrod-Domar Lessons

In other words, the **Rate of Growth** depends as much on the **efficiency of capital investments** as the **amount of capital invested**

In its simplest form, a country that wants to **speed up development**:

1. **Save more**
2. Build more **efficient capital**

Harrod-Domar Lessons

In other words, the **Rate of Growth** depends as much on the **efficiency of capital investments** as the **amount of capital invested**

In its simplest form, a country that wants to **speed up development**:

1. **Save more**

- Difficult for individuals in **developing countries** → Why?
- Can be helped by **Foreign Aid/Investment**

2. Build more **efficient capital**

Harrod-Domar Lessons

In other words, the **Rate of Growth** depends as much on the **efficiency of capital investments** as the **amount of capital invested**

In its simplest form, a country that wants to **speed up development**:

1. **Save more**
2. Build more **efficient capital**

- **Technology** helps with making capital more efficient

Harrod-Domar Simple Example

- In 2011, Indonesia had a **capital-output** ratio of 4

$$\frac{K}{Y} = c = 4$$

If we want a **growth rate of 6%**, **Harrod-Domar** tells us that Indonesia needs a **savings rate** of?

$$\frac{\Delta Y}{Y} = \frac{s}{c} \Rightarrow 6 = \frac{s}{4} \Rightarrow 24 = s$$

Harrod-Domar Growth Model

With theoretical models, you should always ask yourself:

What? Why? Huh?

- **Why** this model?
  - After World War II, much of Europe was destroyed
  - There was a lack of **capital** (K)
  - The **Marshall Plan** was a large **foreign aid package** from the US to Western Europe
  - The aid package greatly sped up recovery of Europe and boosted economic growth
- **What** does it do?
  - Explains how savings, capital, and output are potentially linked together
- **Huh? That's not realistic**

Criticisms of Harrod-Domar

No model is perfect

But good models help explain a small part of life

But these are not without proper criticism:

- Overly simplified
- No **population growth**
- No **technology change**
- The $K = cY$ assumption is concerning
  - Assumes that turning capital into output is easy
  - Assumes **constant returns to capital**
- Policy enacted based on the model did not increase economic growth significantly

Solow Growth Model

Model 02 - Solow Growth Model

Now we can add some **important features**

- Population growth
- Technological change
- Emphasizes looking at outcomes in **per worker** terms

Solow Growth Model Assumptions

1. **Output per worker** y depends only on the amount of **capital per worker** k
2. Every worker **saves a proportion** s of their income
3. **Population grows** at rate n
4. **Capital depreciates** at rate δ
5. **Capital stock** depends on new **investment**

Solow Growth Model Assumptions

1. Output per worker y depends only on the amount of **capital per worker** k

$$y = f(k)$$

- $f()$ is **increasing** (more capital leads to more output)
- $f()$ is **concave** (decreasing returns to capital)

2. Every worker **saves a proportion** s of their income

3. Population grows at rate n

4. Capital depreciates at rate δ

5. Capital stock depends on new **investment**

Solow Growth Model Assumptions

1. **Output per worker** y depends only on the amount of **capital per worker** k
2. Every worker **saves a proportion** s of their income

$$0 \leq s \leq 1$$

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5. **Capital stock** depends on new **investment**

- Every time period workers save some of their income $sf(k)$
- **However**, capital **depreciates** so we lose δk
- The **populations grows** at rate n so the **capital per worker** gets smaller by nk

Solow - Change in Capital per Worker

$$\Delta k = sf(k) - nk - \delta k$$

- Δk: Growth of capital per worker
- $sf(k)$: Savings
- nk: Net new workers
- δk: Capital depreciation

Solow - Change in Capital per Worker

$$\Delta k = sf(k) - nk - \delta k$$

- Δk**: Growth of capital per worker**
  - The more capital a worker has to work with, the more output that they can produce
  - The change in **capital per worker** depends on the other components
- $sf(k)$: Savings
- nk: Net new workers
- δk: Capital depreciation

Solow - Change in Capital per Worker

$$\Delta k = sf(k) - nk - \delta k$$

- Δk: Growth of capital per worker
- $sf(k)$: **Savings → (Positive)**
  - Each worker saves a proportion of their income and is reinvested into **“capital in the future”**
- nk: Net new workers
- δk: Capital depreciation

Solow - Change in Capital per Worker

$$\Delta k = sf(k) - nk - \delta k$$

- Δk: Growth of capital per worker
- $sf(k)$: Savings
- nk: **Net new workers → (Negative)**
  - Population (workers) grow at a **rate** $n \geq 0$ (usually very small)
  - As there are more people, there is **less capital per worker** determined by nk
- δk: Capital depreciation

Solow - Change in Capital per Worker

$$\Delta k = sf(k) - nk - \delta k$$

- Δk: Growth of capital per worker
- $sf(k)$: Savings
- nk: Net new workers

- **δk: Capital depreciation → (Negative)**
  - Capital requires service (repairs) → We lose δk every period
  - $0 < \delta < 1$

Solow Growth Model - Steady State

The **Solow Model** allows us to consider a **steady state** level of capital

- **Steady State:** When the economy has fully adjusted and there is no change in some variable
  - The economy is in an **equilibrium** that is **stable**
  - **Output** and **capital per worker** are no longer changing

We want k to be in **steady state**

- This means that $\Delta k = 0$ → Because k is no longer changing
- We call this level of **capital** k^*

Solow Growth Model - Steady State

When the economy is in **steady state** k^* we have:

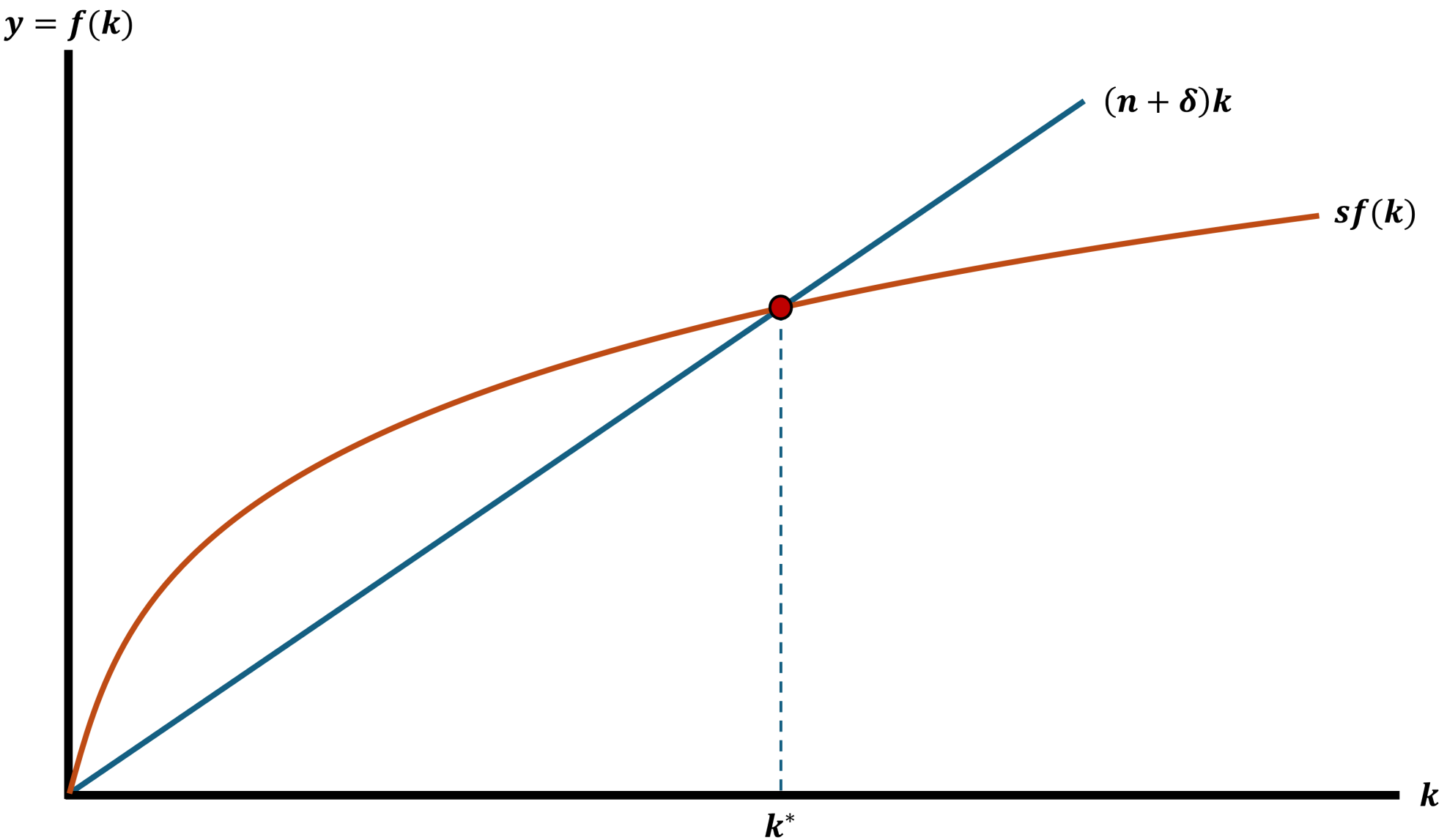
$$\Delta k = 0 = sf(k^*) - (n + \delta)k^*$$

$$sf(k^*) = (n + \delta)k^*$$

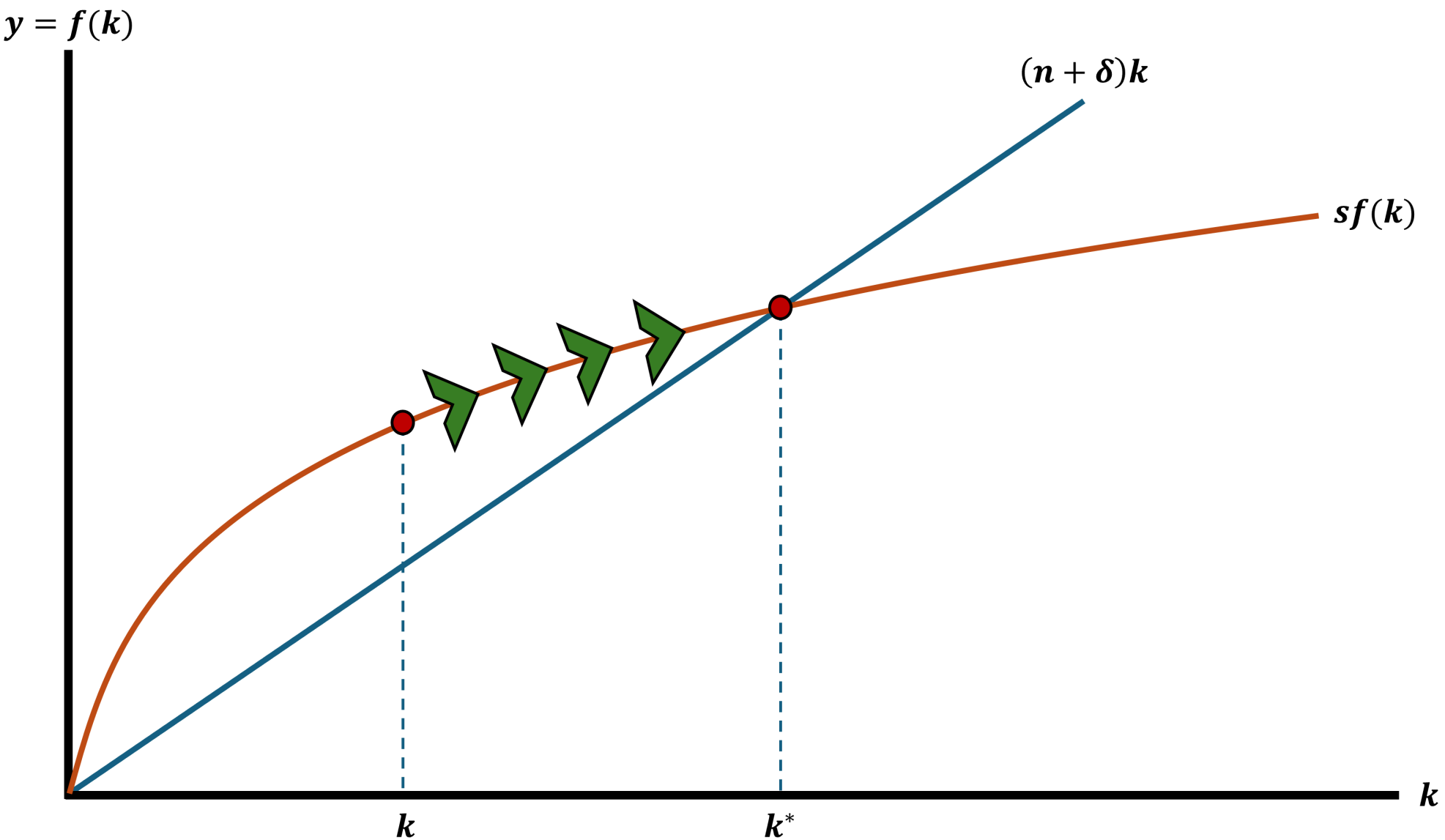
More than the math, I want you to understand this intuitively

- Graphs are great to be able to talk about this

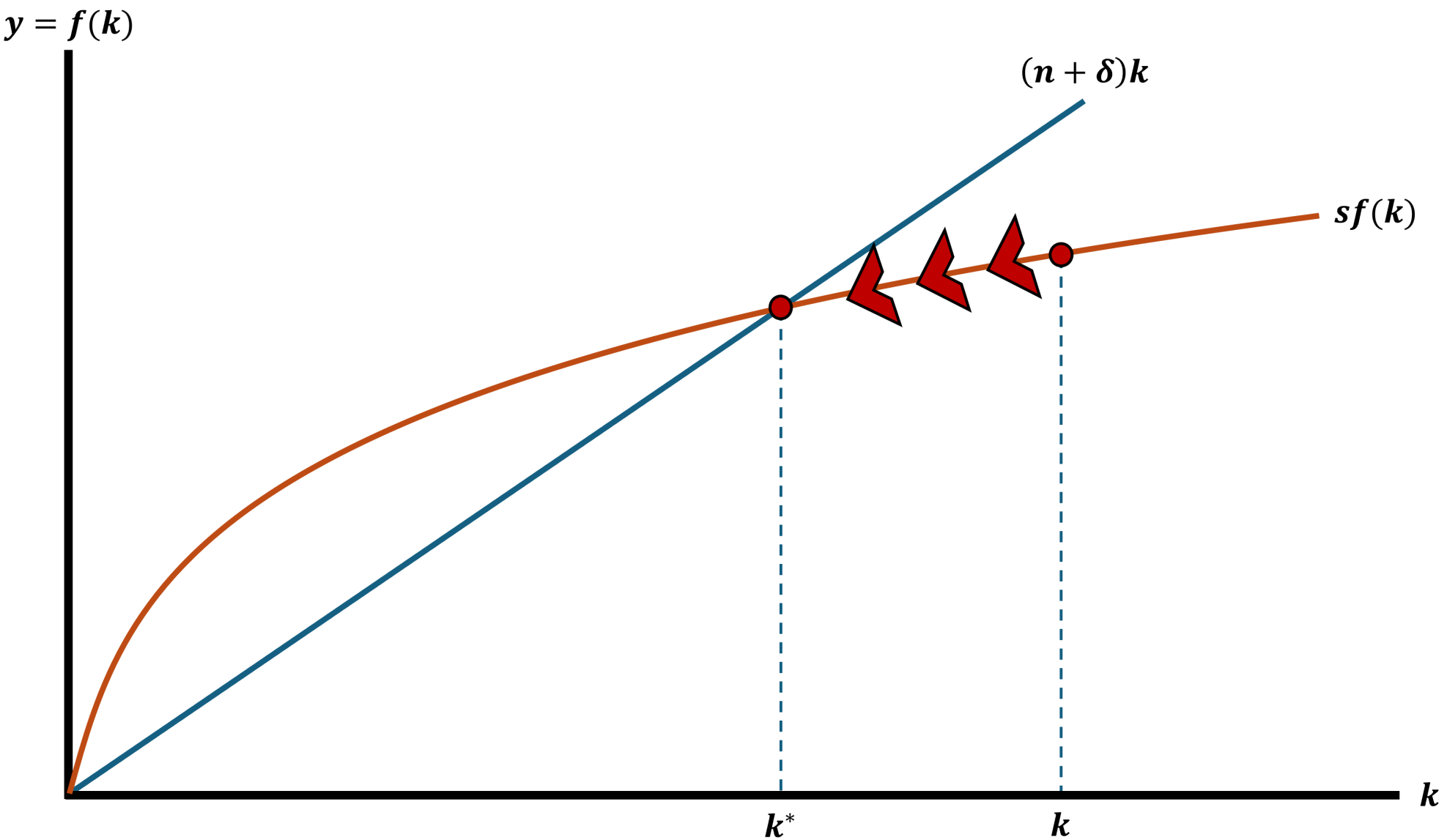
Steady State



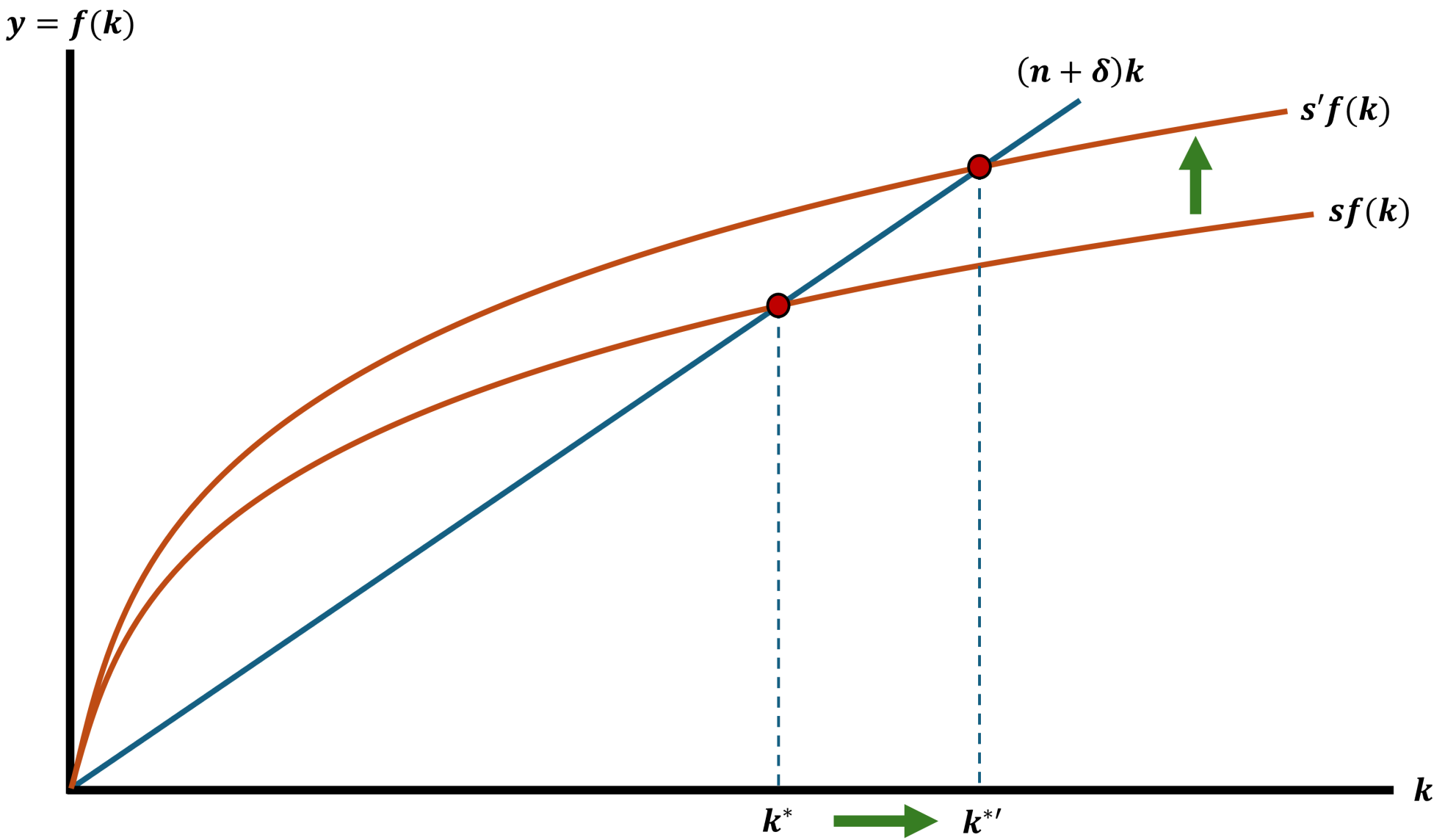
Out of Steady State



Out of Steady State



Increase in Savings Rate



Solow Growth Model Dynamics

Be aware of all the possible moving pieces in this model

It allows us to **explore the effects of changes in**:

- s: Savings Rates
- δ: Depreciation Rate
- n: Population Growth Rate

Solow Growth Model

What? Why? Huh?

- **Why** this model?
  - It is a simple and intuitive way of understanding how **savings, population growth,** and technology change impacts **long-run economic growth**

- **What** does it do? → Decomposes growth into **two key forces**

1. **Capital accumulation** through savings and investment
2. **Population growth** as the labor force expands

- **Huh? Again with this fantasy stuff?**

Criticisms of Solow

- There is a constant savings rate that is **exogenously given**
- Ignores **human capital**
- Predicts too much convergence
  - Economies with the same rates (s, n, δ) **should** reach the same

Structural Change Models

Lewis Two-Sector Model

Was the general theory of the development process in **surplus-labor developing nations** in the 60s and 70s

- Focuses on **structural transformation** of a primarily **subsistence economy**
  - ***Definition:*** A major alteration in the industrial composition of any economy
  - Usually we talk about moving from subsistence agricultural sector to manufacturing sector

Model Set Up

There is an **underdeveloped economy** with:

- Two Sectors
  1. A traditional, overpopulated, rural subsistence sector
  2. A high-productivity, modern, urban industrial sector

- Primary Focus
  - Process of labor transfer/movement between sectors
  - Growth of output and employment in the **industrial** sector

> The transfer of labor between sectors and employment growth in the **industrial** sector is due to **expansion in the industrial sector**

Industrial Sector Expansion

The speed at which the **industrial sector** grows is determiend by **investment and capital accumulation** in that sector

- Capitalists make profits in the **industrial sector** above paid **wages**
- Assume that they invest it **all** back into the sector (more capital enters)
- **Capital stock** increases and they hire more labor

Some questions/doubts arise

1. Where is all the labor coming from? I thought the other side was a **subsistence agricultural sector**?

2. I thought economists didn't believe in positive profits

3. **Capital** only increases in the industrial sector?

Subsistence Agricutural Sector

There are two primary assumptions to consider

1. There is a **surplus of labor**

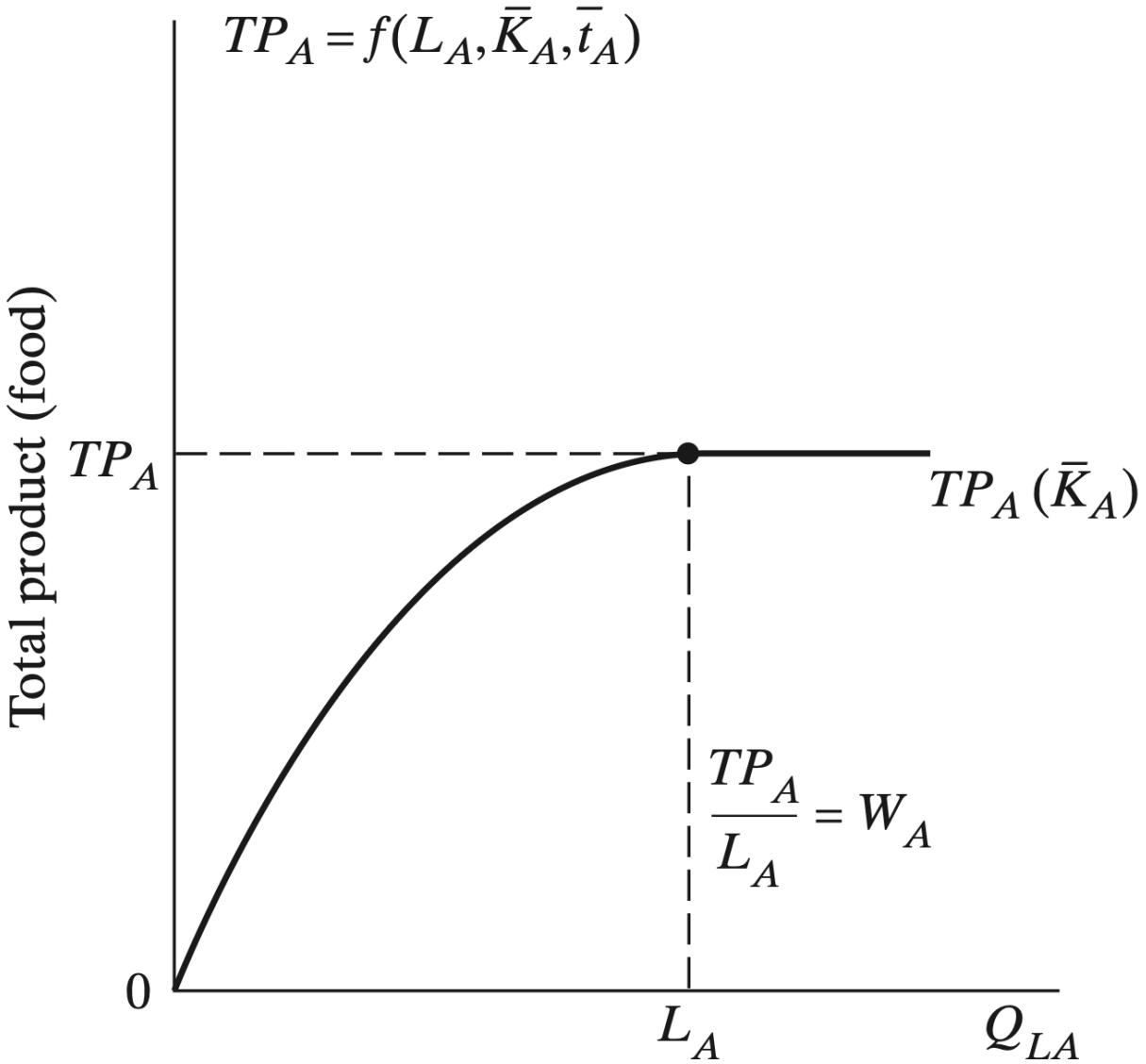
- Marginal productivity of labor (MP_{LA}) is zero

2. All **rural workers** share their output equally

- Rural wages are determined by the average product of labor

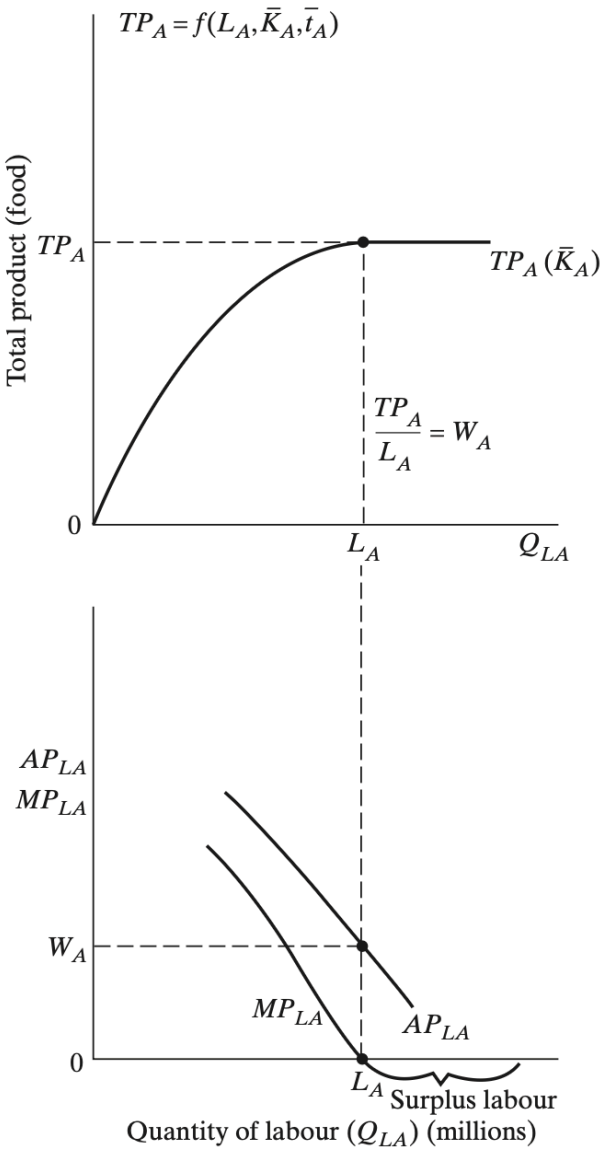
- There are L_A agricultural workers that produce TP_A food

Subsistence Agricultural Sector (Production)

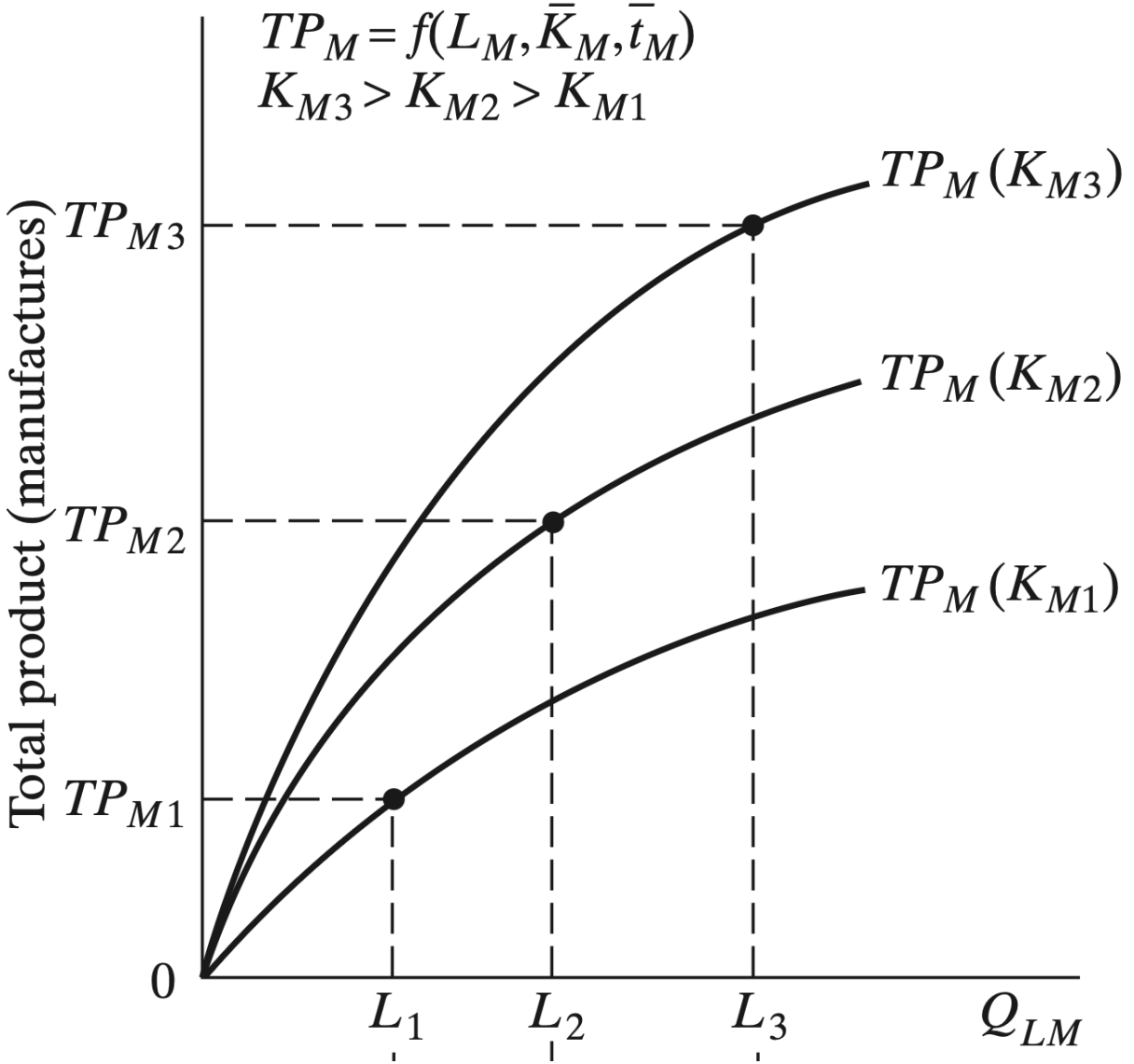


Subsistence Agricultural Sector (Labor Demand)

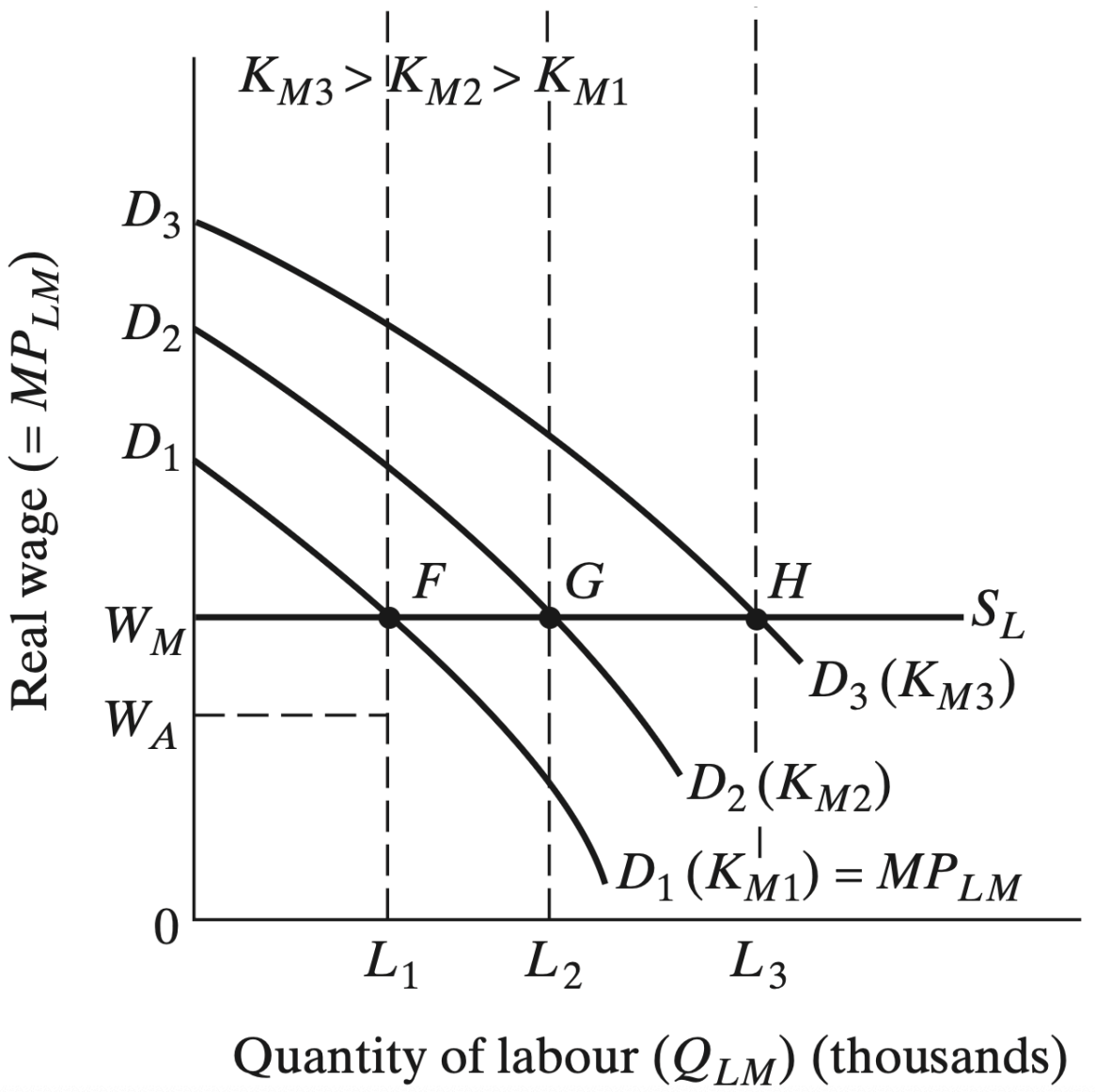
Subsistence Agricultural Sector (Both)



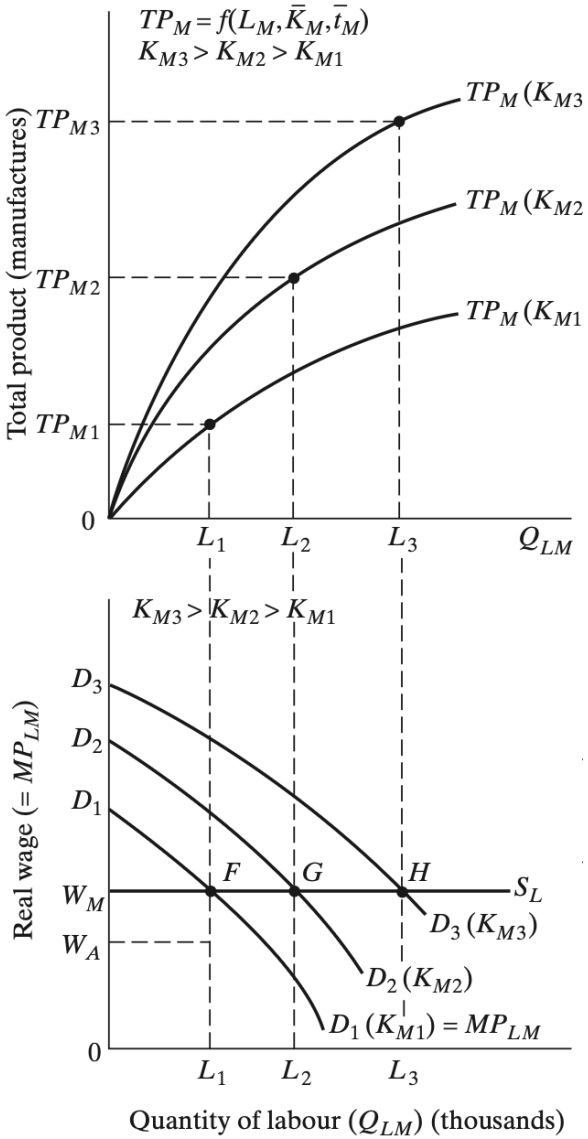
Industrial Sector (Production)



Industrial Sector (Labor Demand)



Industrial Sector (Both)

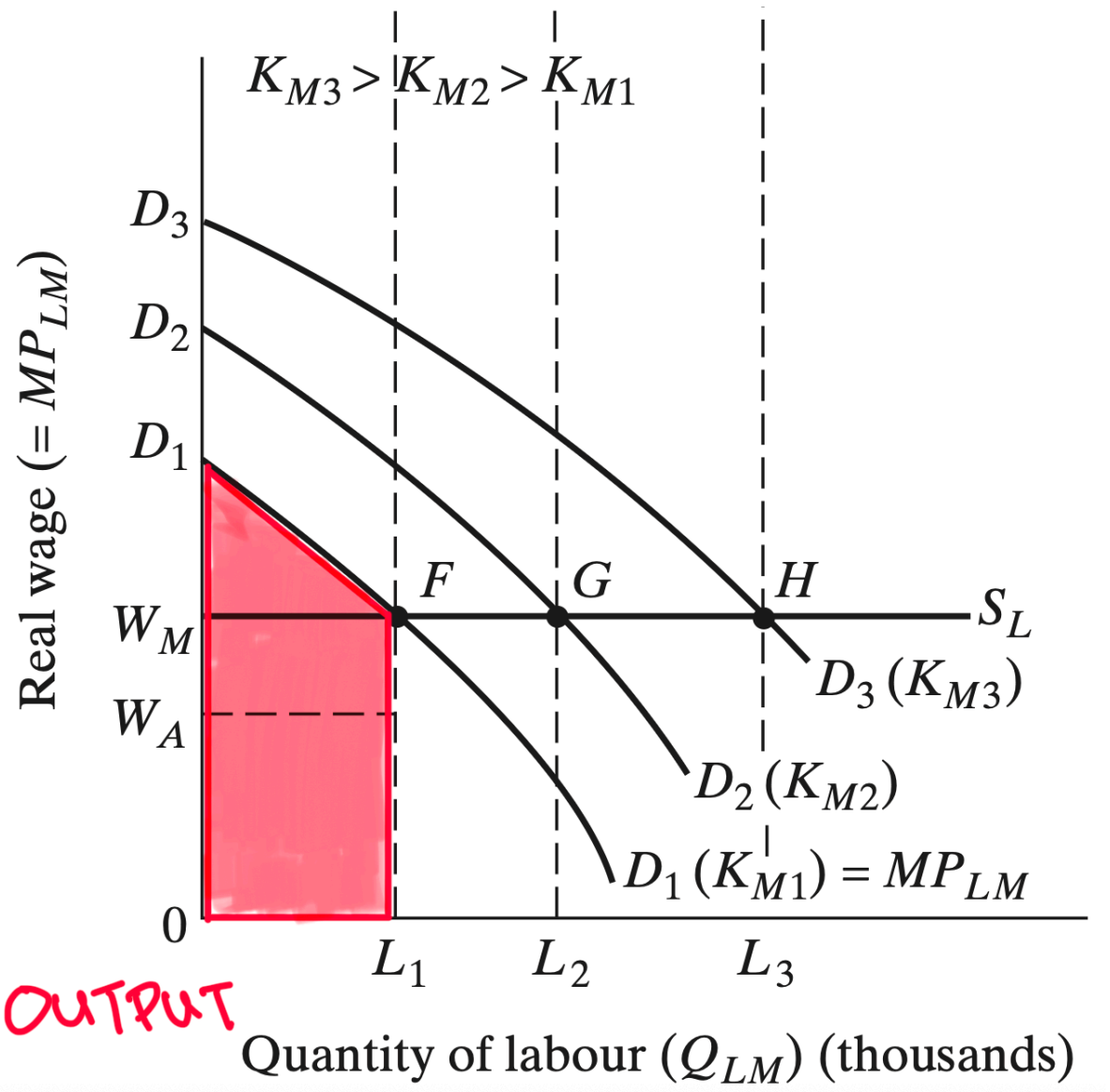


Wage Differences

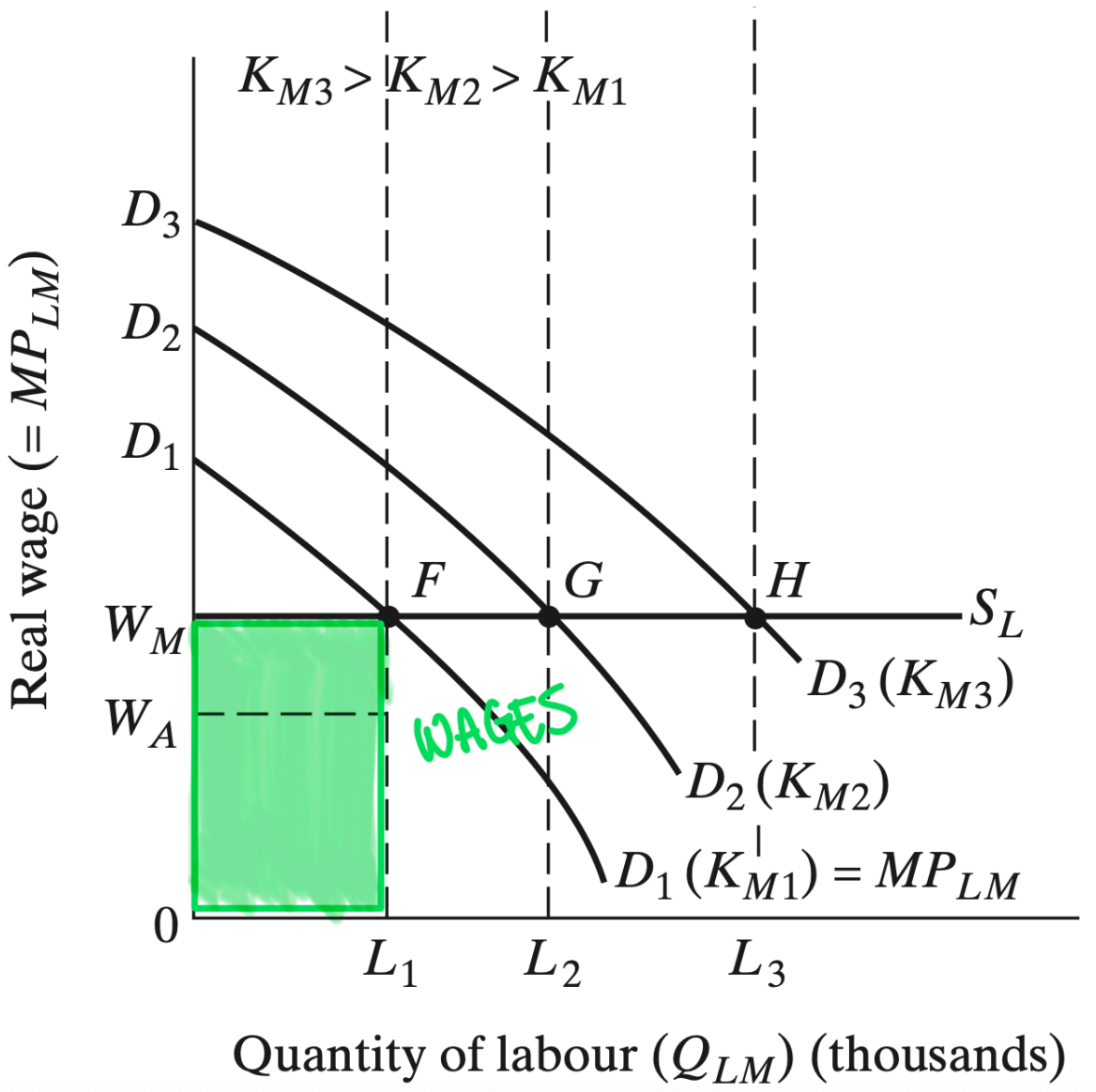
Agricultural wages are lower than **wages in the industrial sector**

- Supply of agricultural labor is assumed to be **perfectly elastic/unlimited**
  - This means that at industrial wages (W_M) above agricultural wages (W_A), the industrial sector can hire **as many surplus workers as they want without fear of raising wages**
- We assume labor to have diminishing returns (1 more labor ≠ 1 more output)
- The profit-maximizing industrial sector hires labor until their **marginal product** is equal to **the real wage**

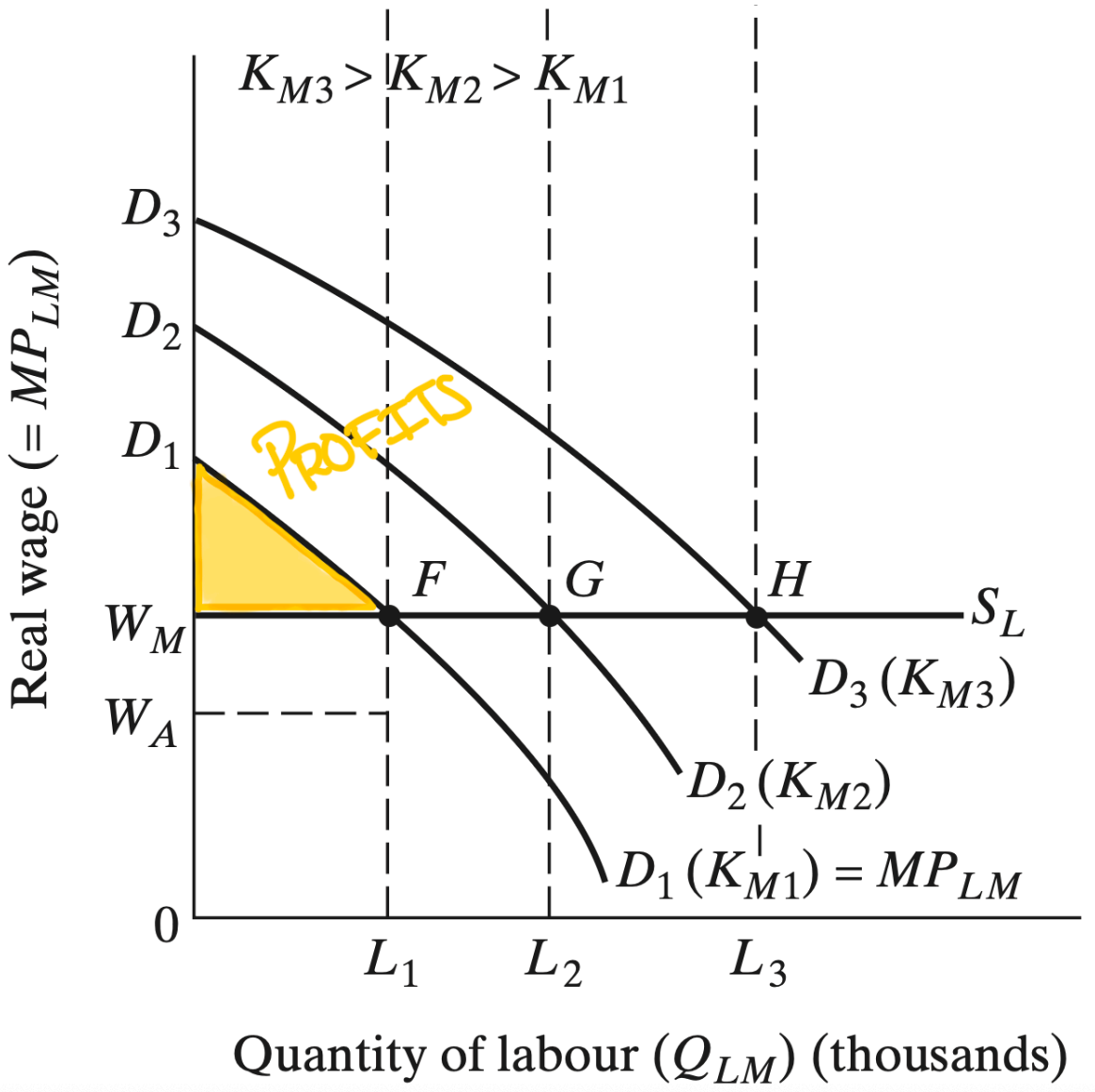
Industrial Sector Output



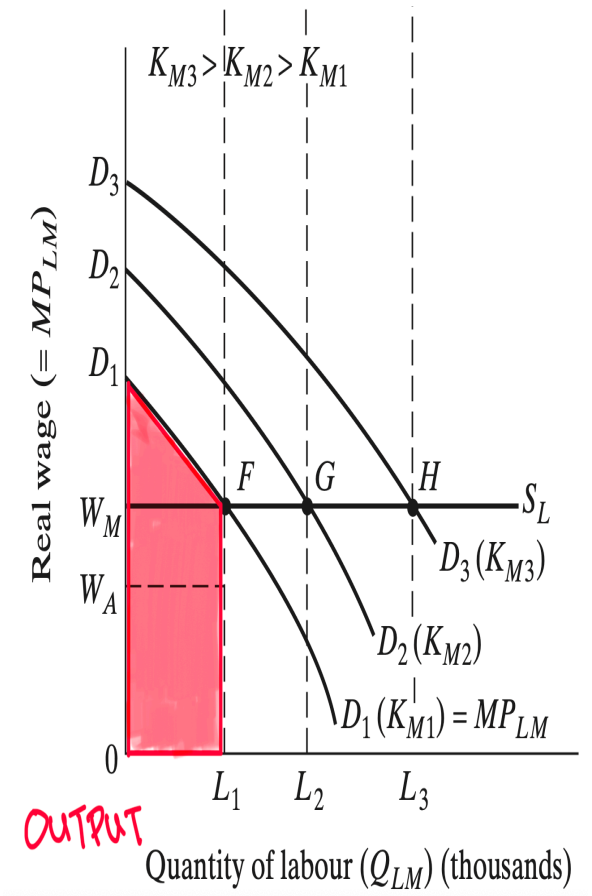
Industrial Sector Wages

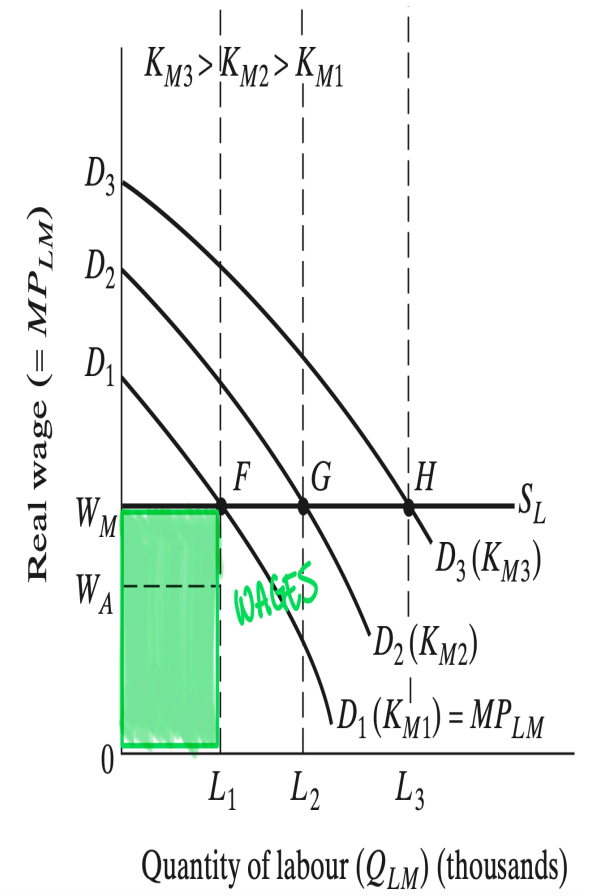


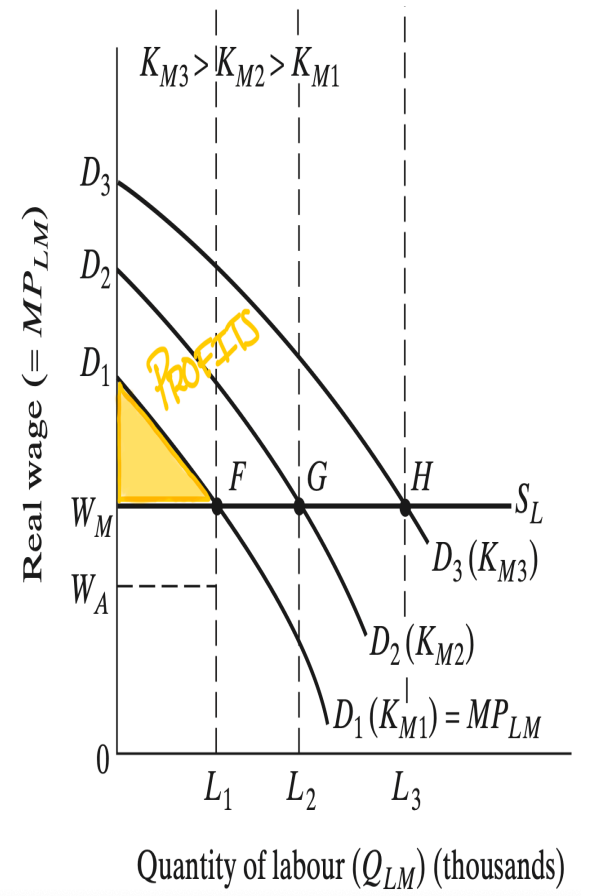
Industrial Sector Profits



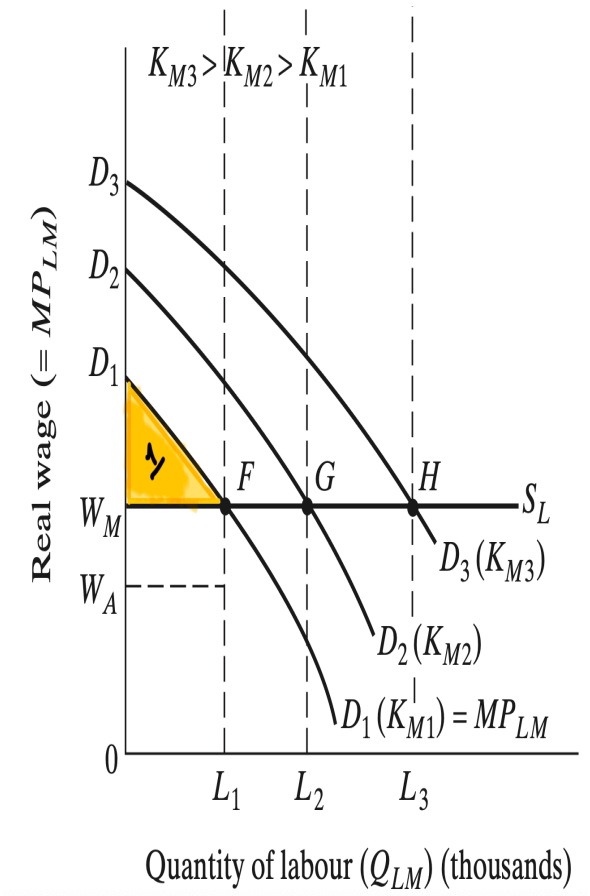
All Together

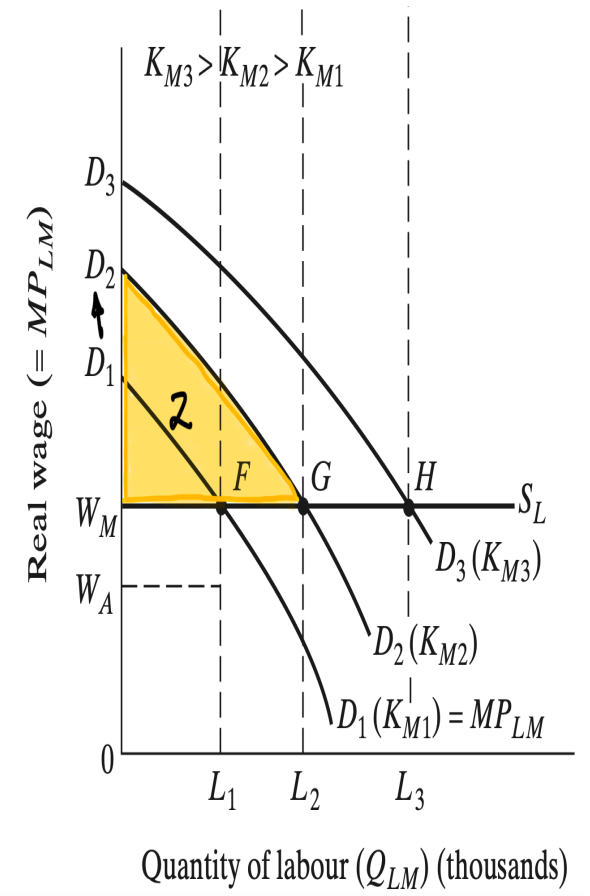


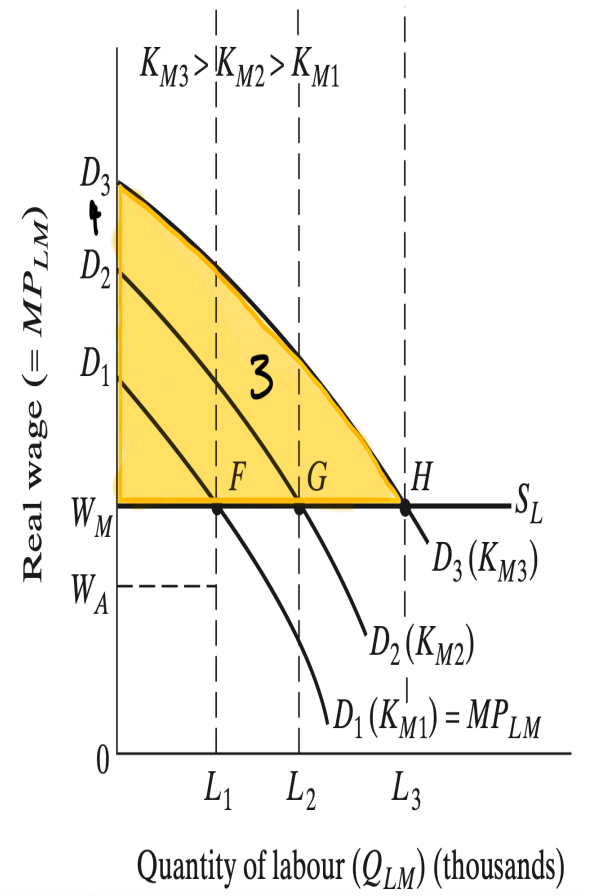




Investments







Investments

Because the industrial sector owners make a **positive profit** and they fully reinvest those back into **capital**

We get self-sustaining growth

- This will happen until all **surplus rural labor** is absorbed into the industrial sector
- The **industrial sector** can extract additional workers **at a higher cost** since it would now imply a loss of food production
- This is the **Lewis Turning Point**
  - The labor supply curve becomes **positively sloped** in the industrial sector and wages increase in the economy
  - Eventually the market goes through a **structural transformation** where it shifted from a traditional rural agricultural to a modern urban industrial setting