

A woman's silhouette is shown from the back, looking at a display of various sunglasses on shelves. The shelves are arranged in a grid, and the sunglasses are of different colors and styles. The background is bright, making the sunglasses stand out.

INTERMEDIATE

MICROECONOMICS

NINTH EDITION

HAL R. VARIAN

Chapter 33

Production

Exchange Economies (revisited)

- ◆ **No production, only endowments, so no description of how resources are converted to consumables.**
- ◆ **General equilibrium: all markets clear simultaneously.**
- ◆ **1st and 2nd Fundamental Theorems of Welfare Economics.**

Now Add Production ...

- ◆ **Add input markets, output markets, describe firms' technologies, the distributions of firms' outputs and profits ...**

Now Add Production ...

- ◆ **Add input markets, output markets, describe firms' technologies, the distributions of firms' outputs and profits ... That's not easy!**

Robinson Crusoe's Economy

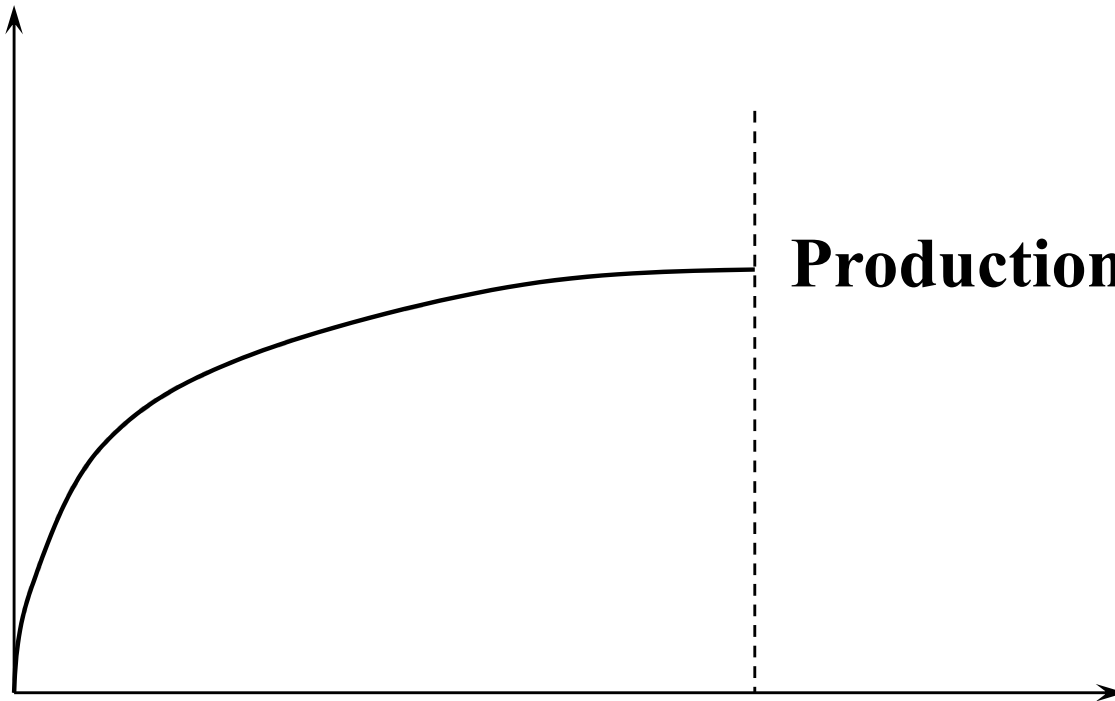
- ◆ **One agent, RC.**
- ◆ **Endowed with a fixed quantity of one resource -- 24 hours.**
- ◆ **Use time for labor (production) or leisure (consumption).**
- ◆ **Labor time = L . Leisure time = $24 - L$.**
- ◆ **What will RC choose?**

Robinson Crusoe's Technology

- ◆ **Technology: Labor produces output (coconuts) according to a concave production function.**

Robinson Crusoe's Technology

Coconuts



Production function

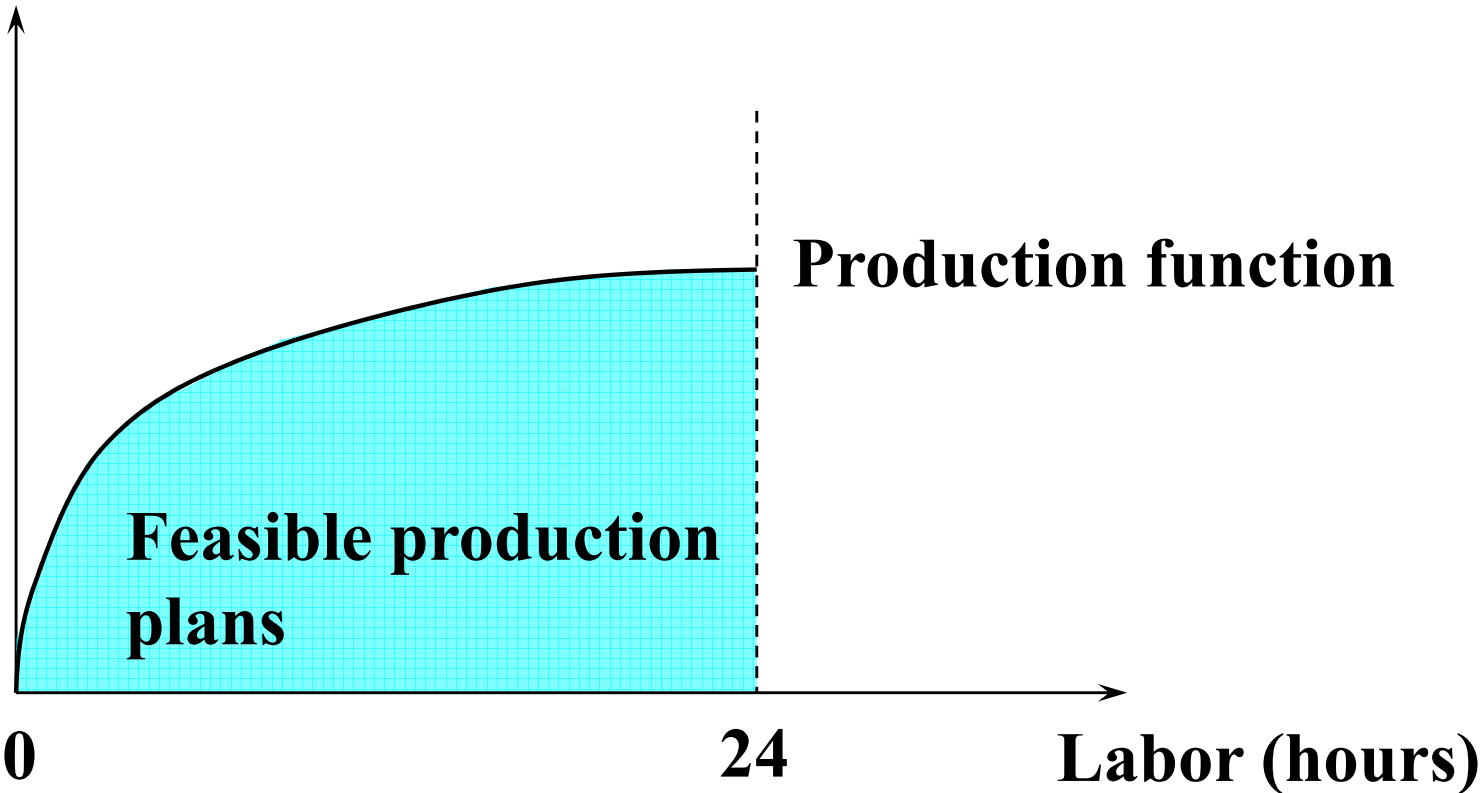
0

24

Labor (hours)

Robinson Crusoe's Technology

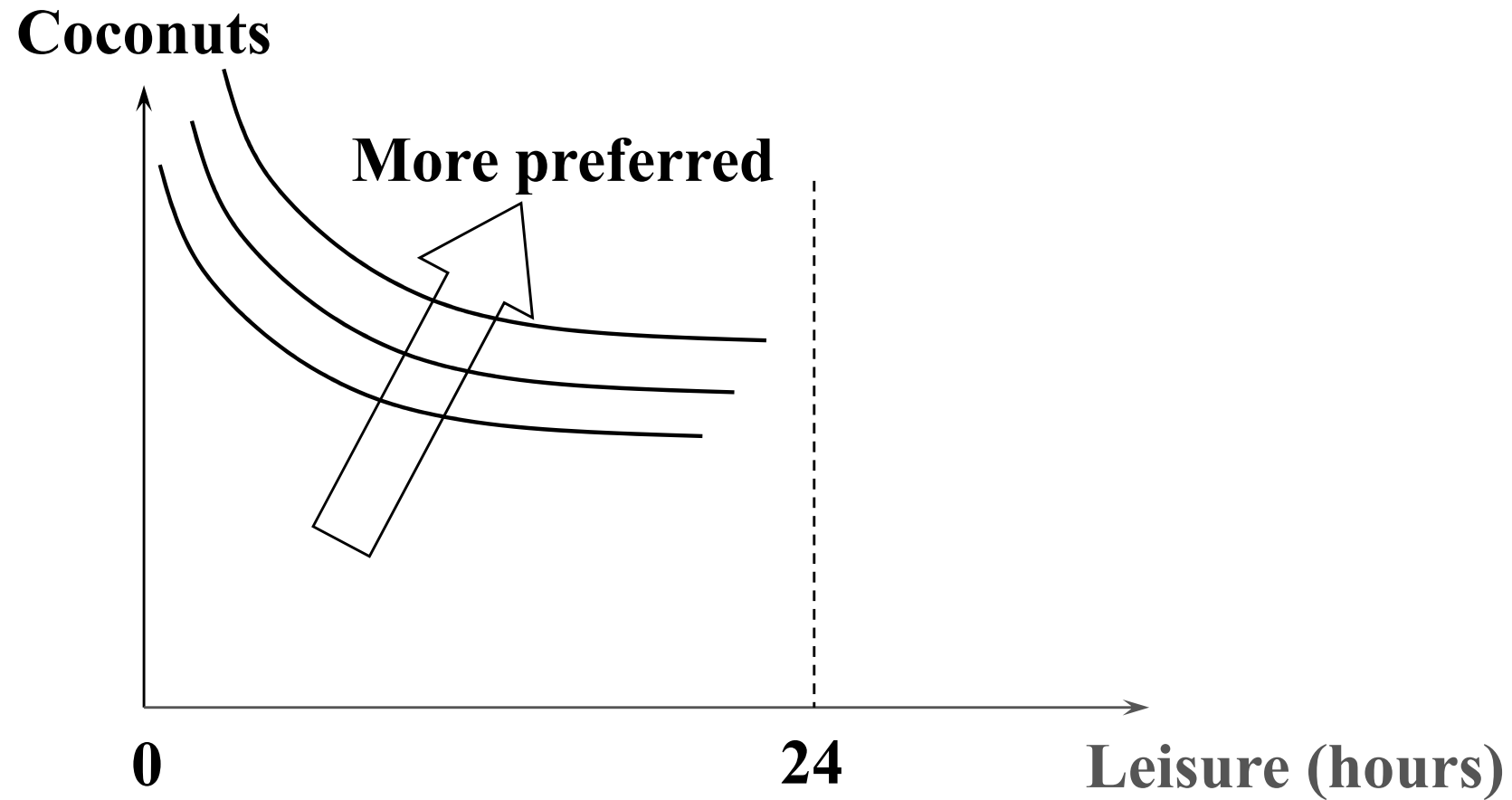
Coconuts



Robinson Crusoe's Preferences

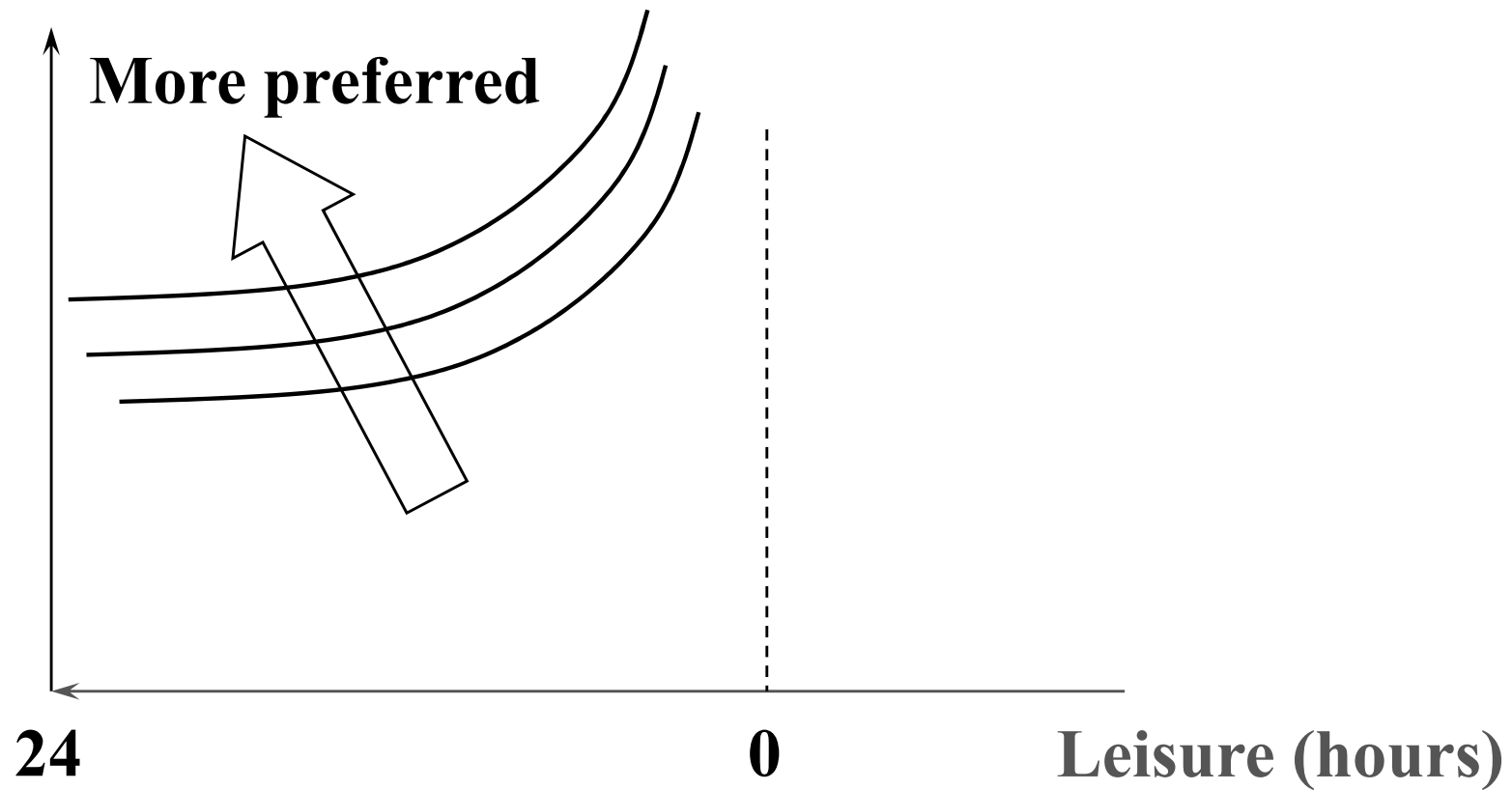
- ◆ **RC's preferences:**
 - **coconut is a good**
 - **leisure is a good**

Robinson Crusoe's Preferences



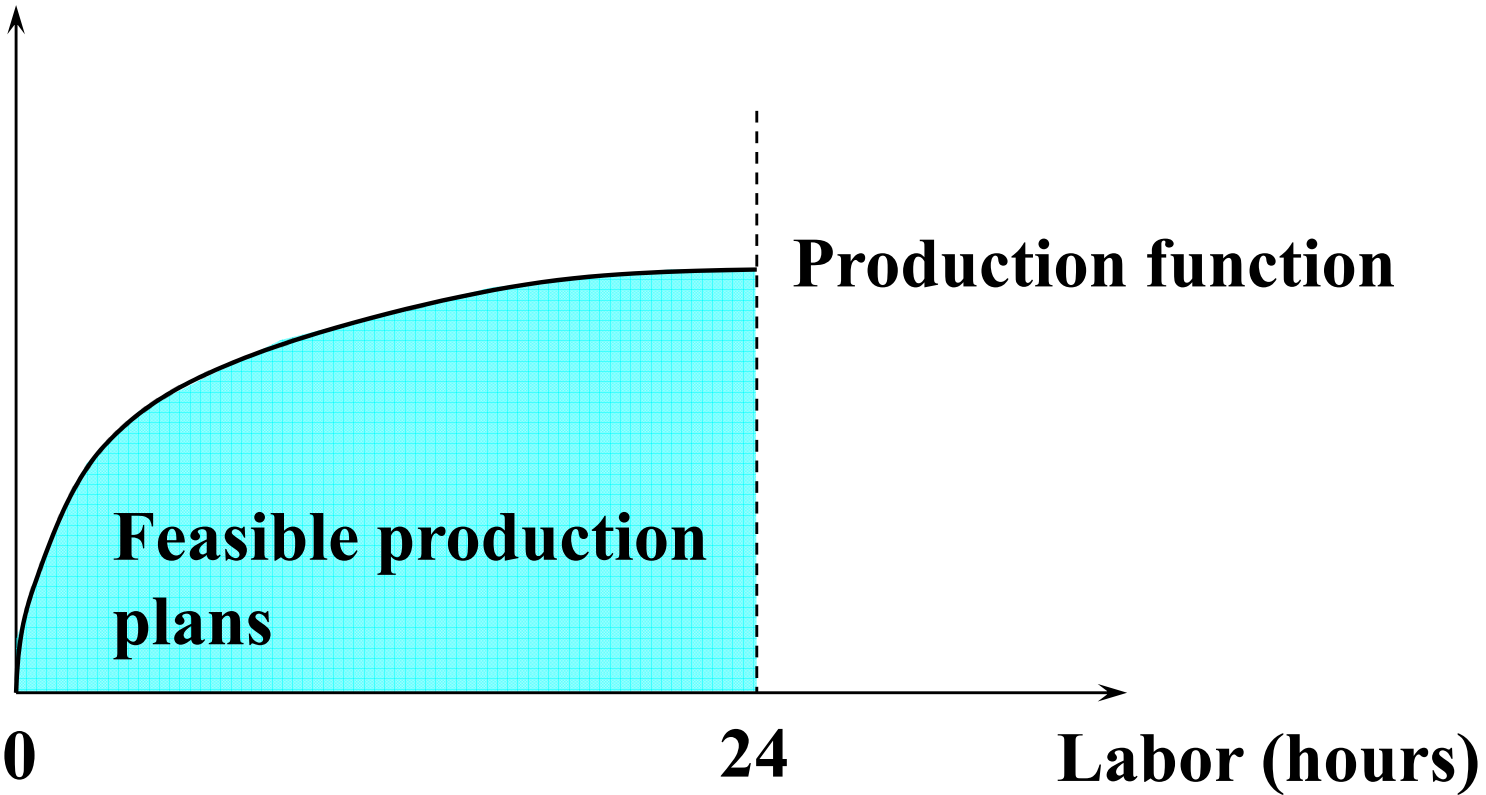
Robinson Crusoe's Preferences

Coconuts



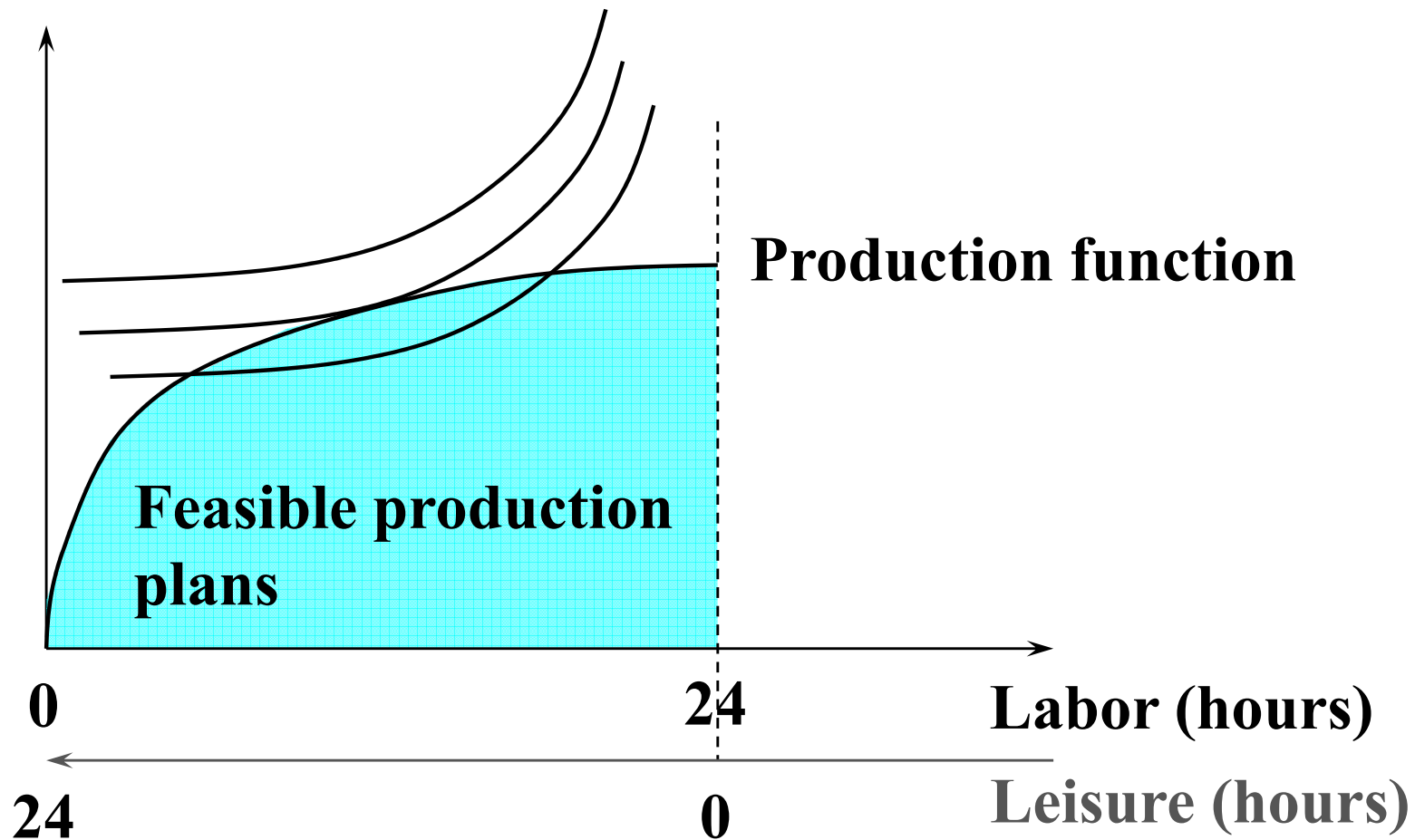
Robinson Crusoe's Choice

Coconuts



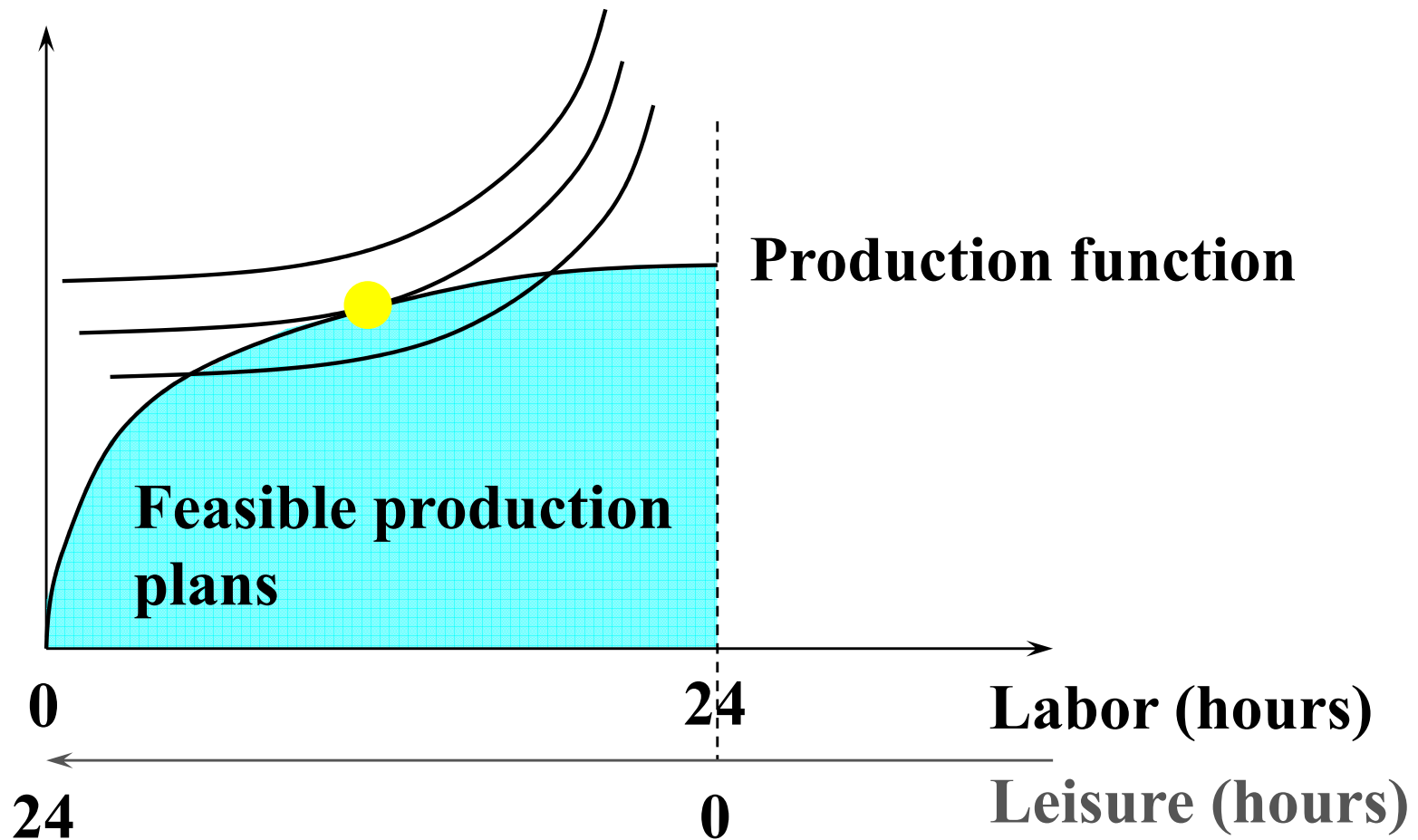
Robinson Crusoe's Choice

Coconuts



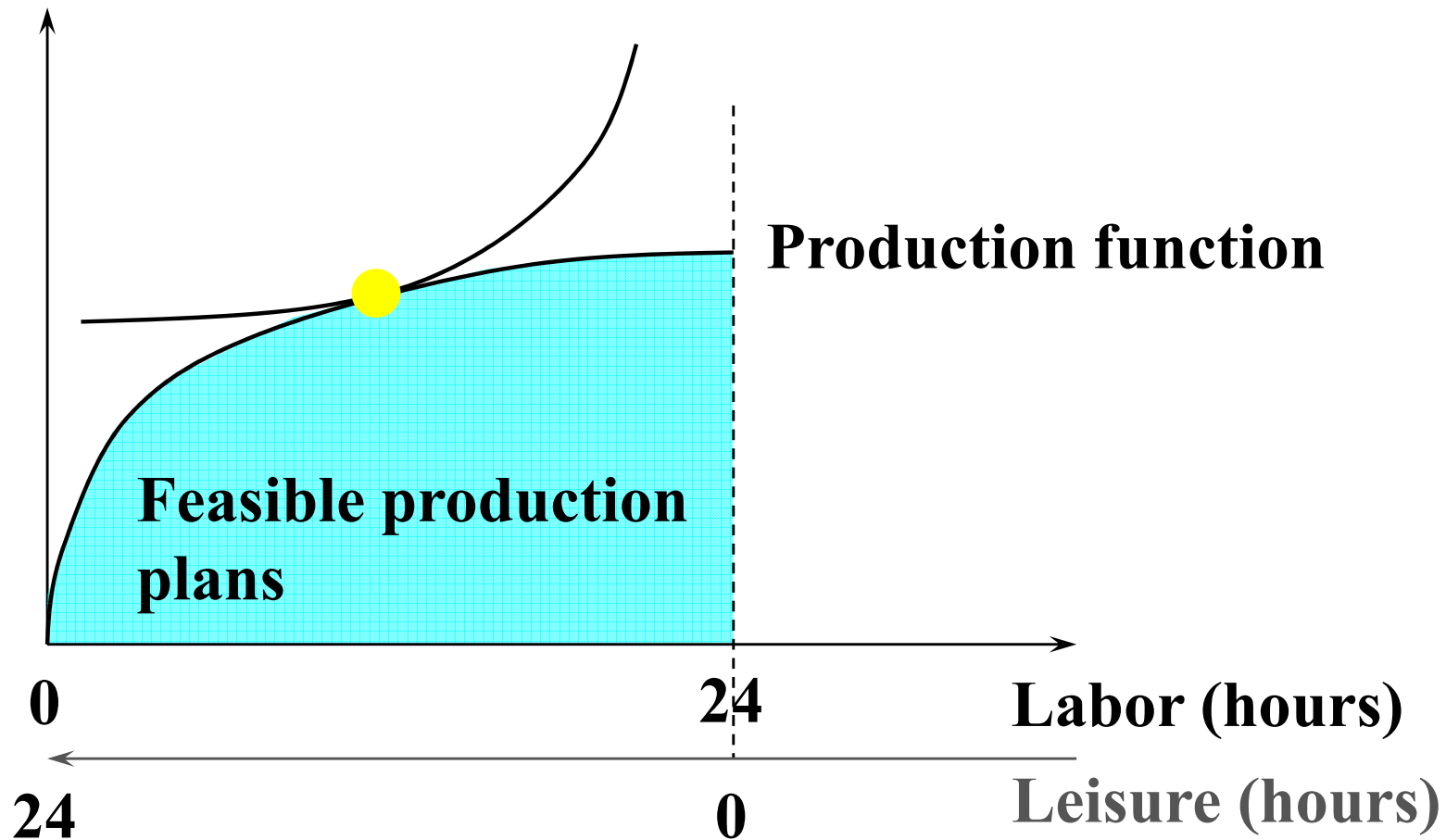
Robinson Crusoe's Choice

Coconuts



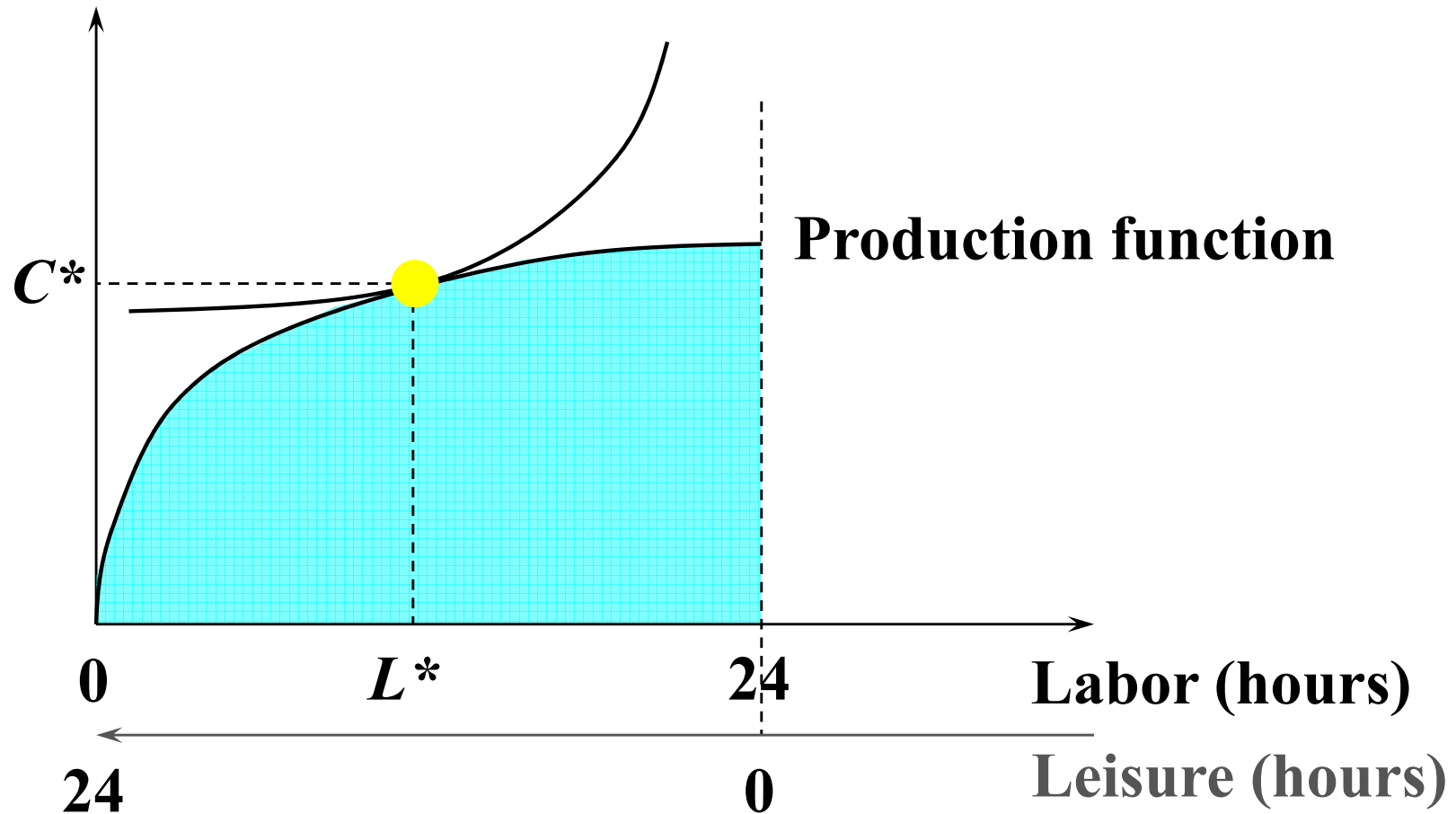
Robinson Crusoe's Choice

Coconuts



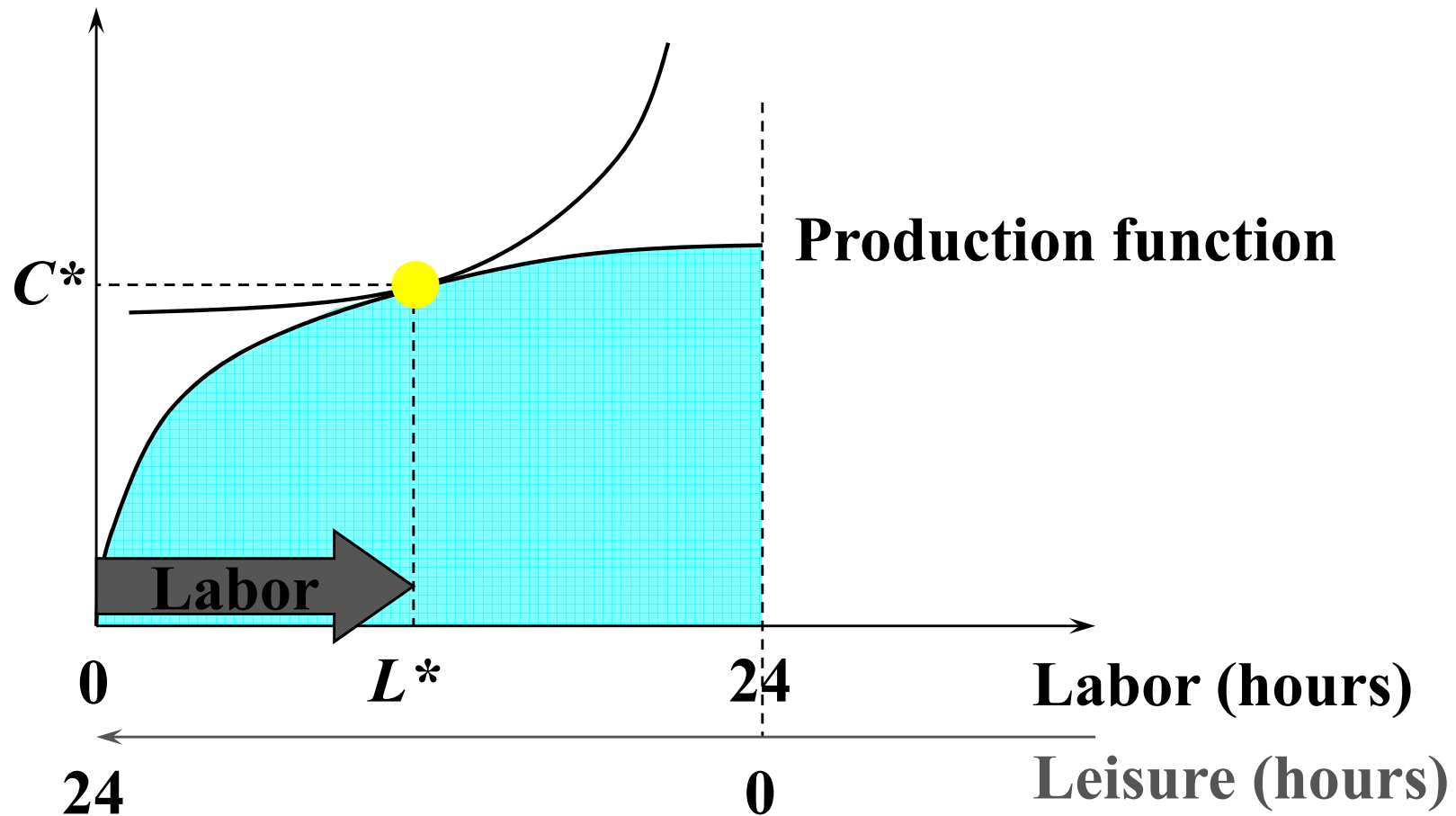
Robinson Crusoe's Choice

Coconuts



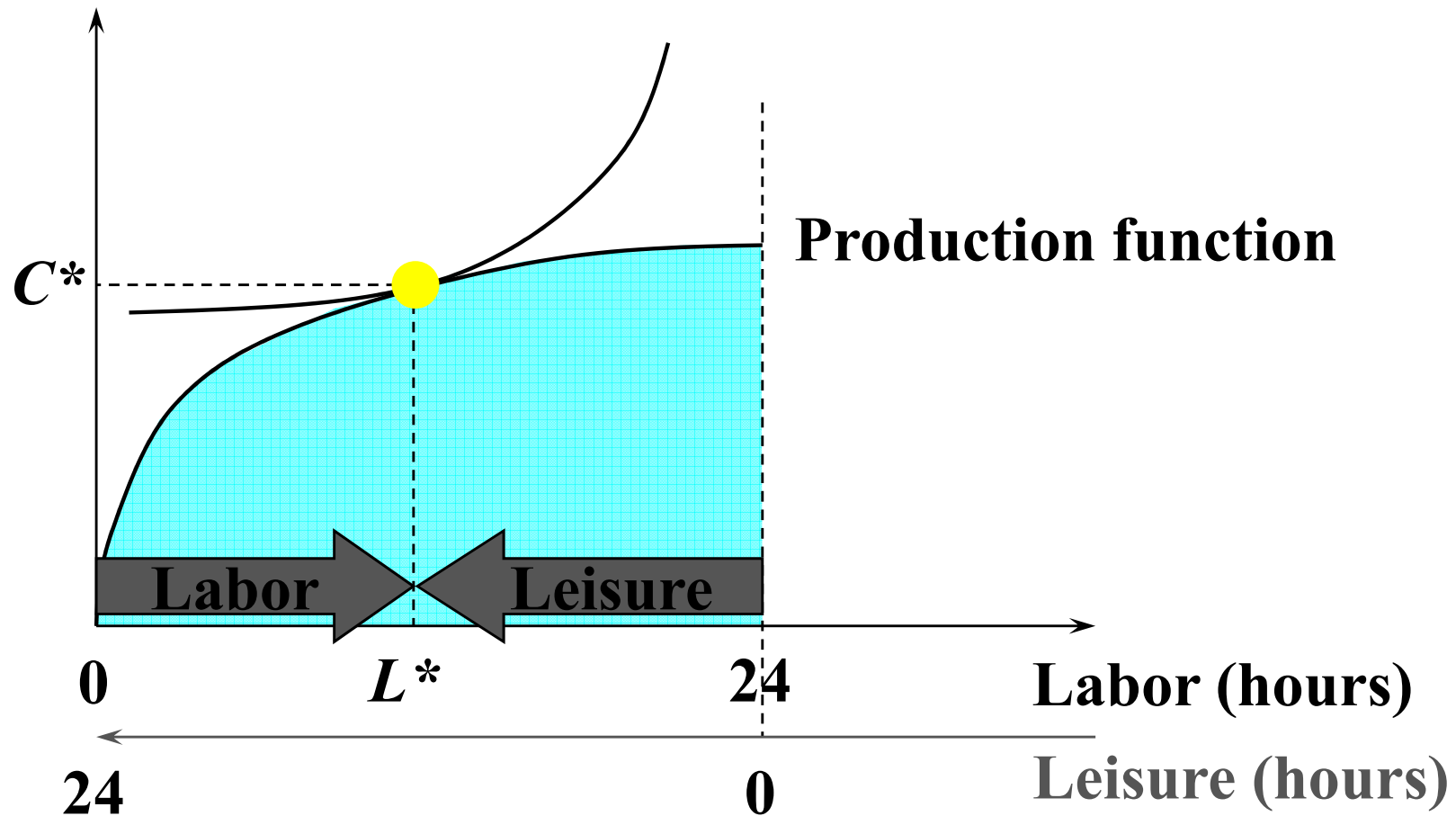
Robinson Crusoe's Choice

Coconuts



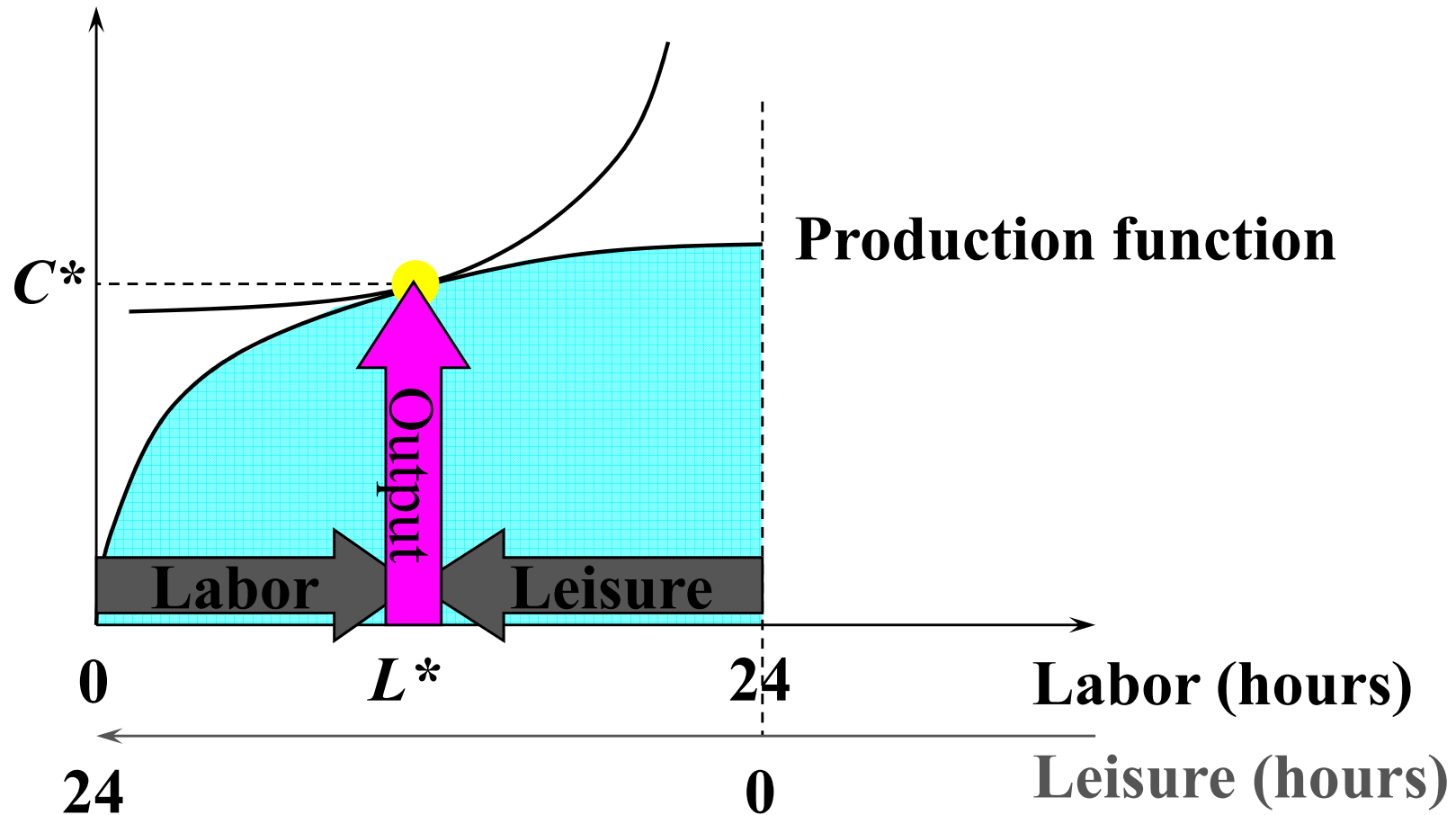
Robinson Crusoe's Choice

Coconuts



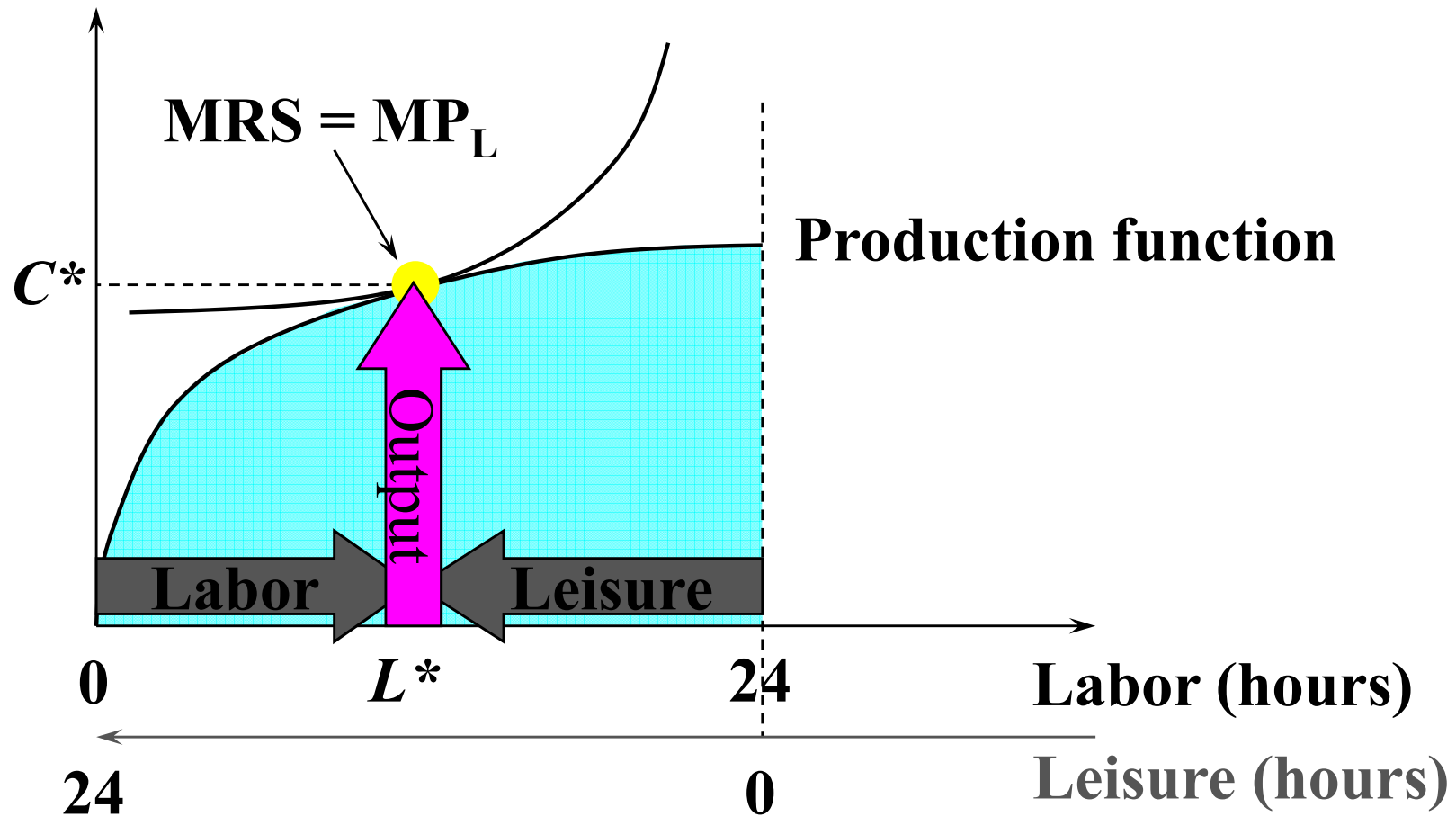
Robinson Crusoe's Choice

Coconuts



Robinson Crusoe's Choice

Coconuts



Robinson Crusoe as a Firm

- ◆ **Now suppose RC is both a utility-maximizing consumer and a profit-maximizing firm.**
- ◆ **Use coconuts as the numeraire good; i.e. price of a coconut = \$1.**
- ◆ **RC's wage rate is w .**
- ◆ **Coconut output level is C .**

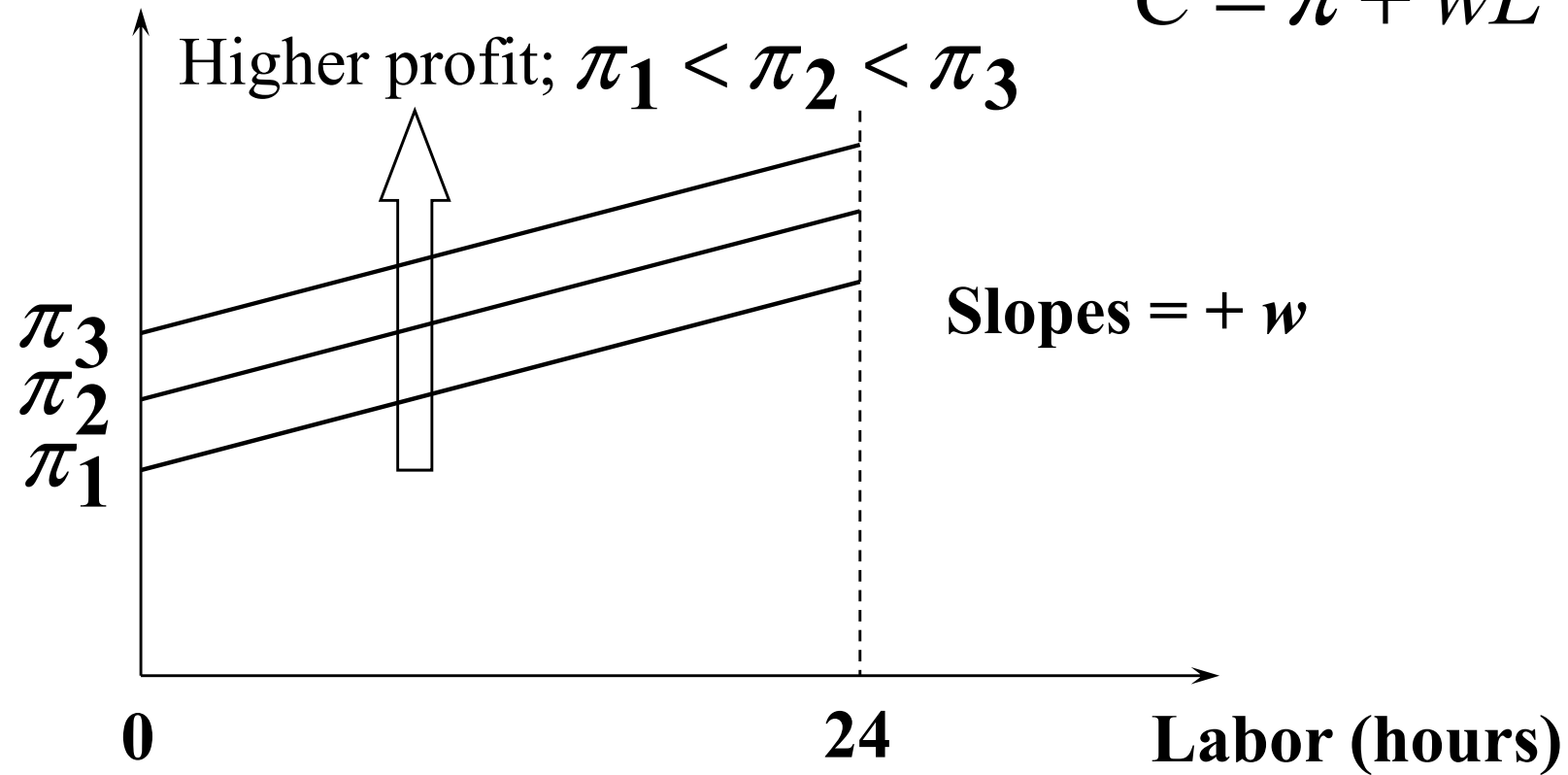
Robinson Crusoe as a Firm

- ◆ RC's firm's profit is $\pi = C - wL$.
- ◆ $\pi = C - wL \Leftrightarrow C = \pi + wL$, the equation of an isoprofit line.
- ◆ Slope = $+ w$.
- ◆ Intercept = π .

Isoprofit Lines

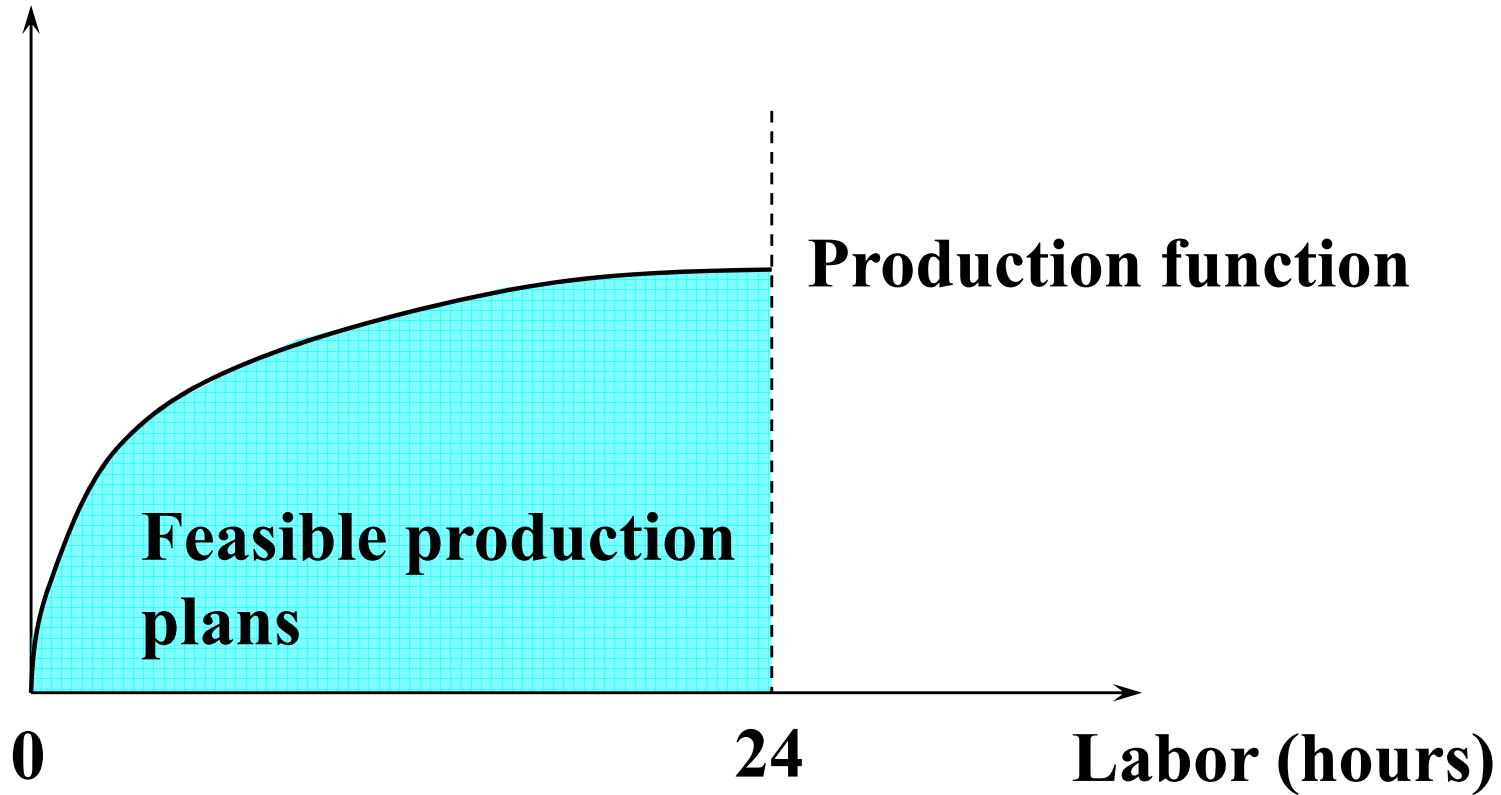
Coconuts

$$C = \pi + wL$$



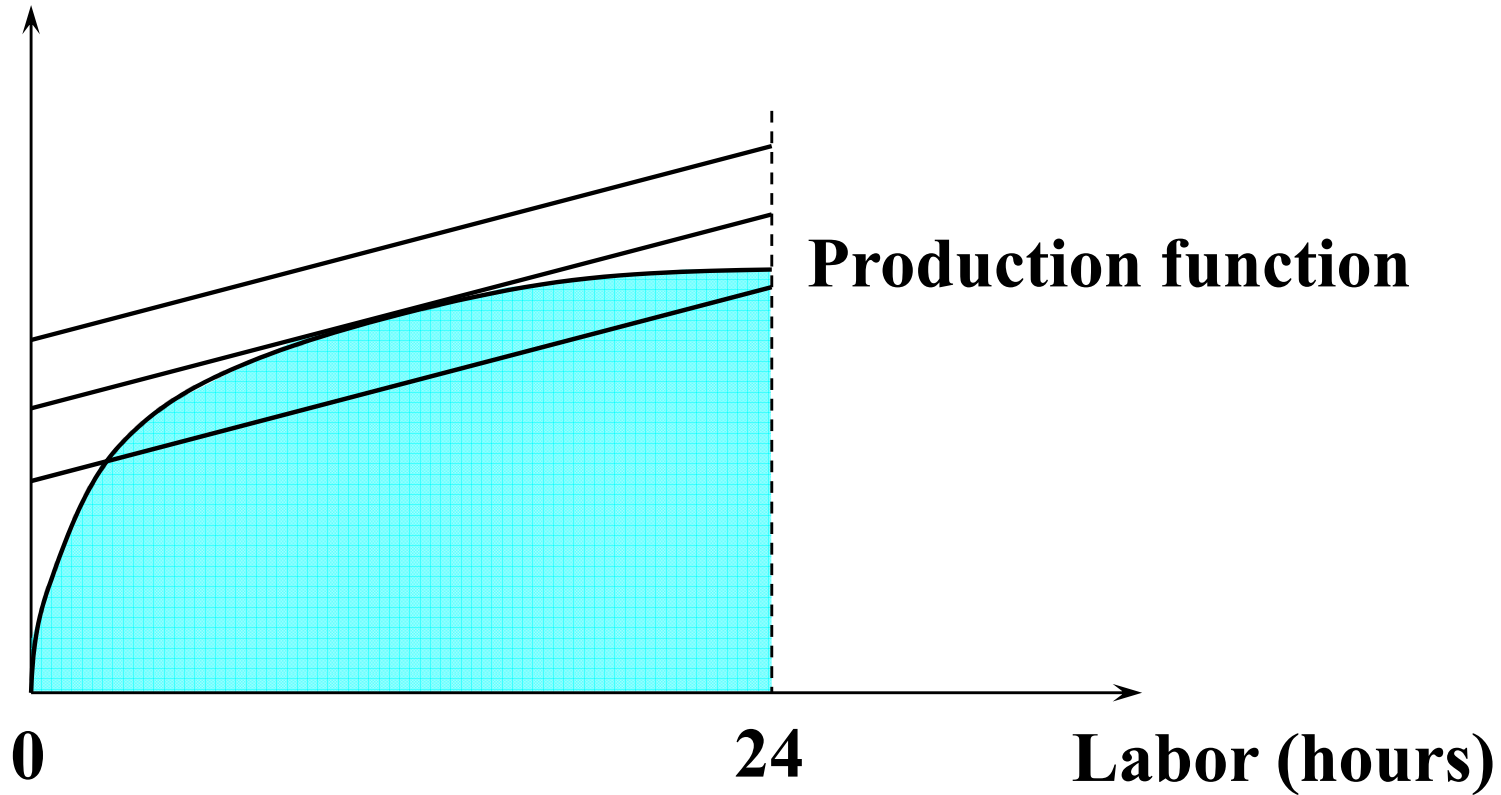
Profit-Maximization

Coconuts



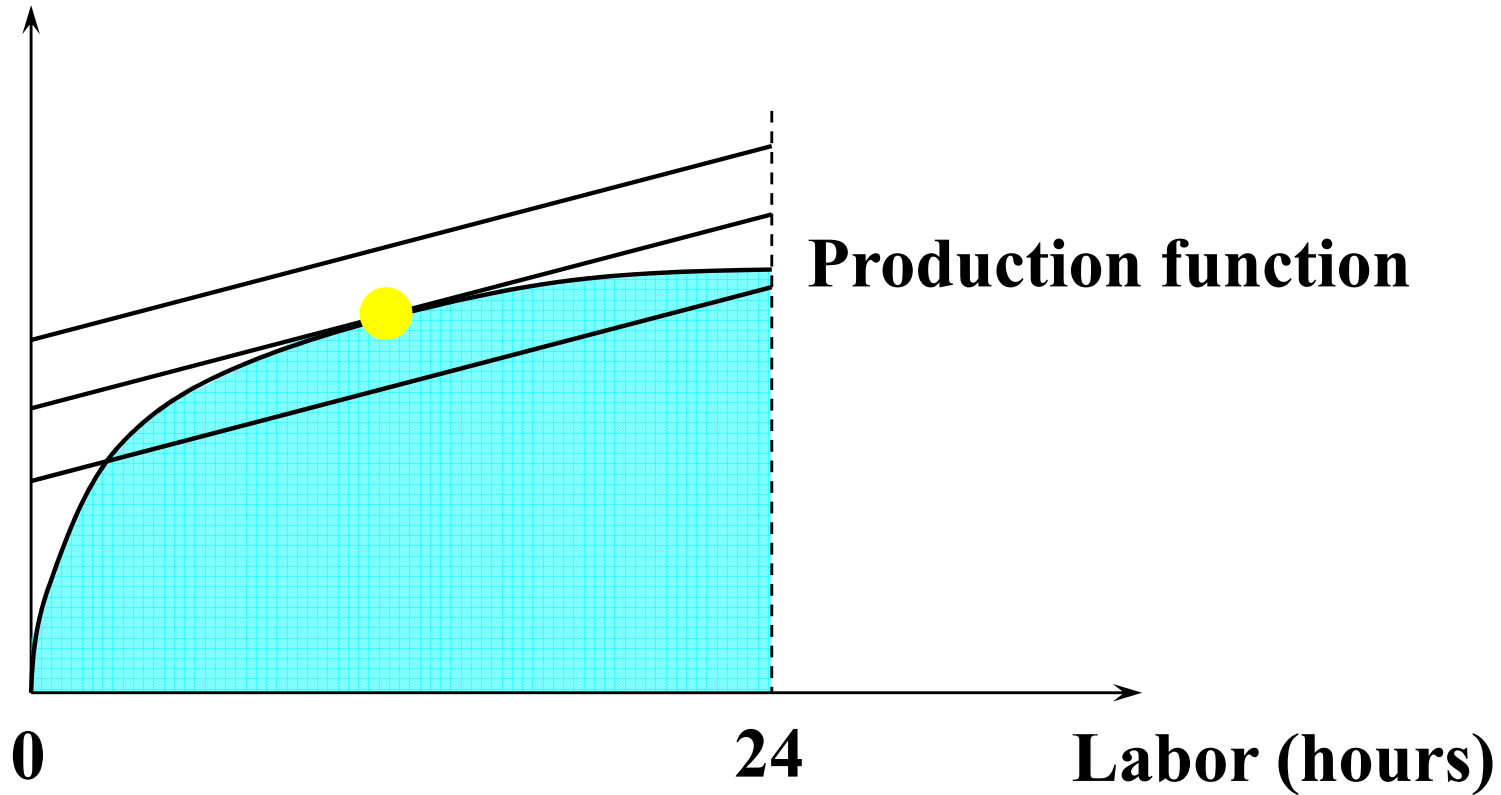
Profit-Maximization

Coconuts



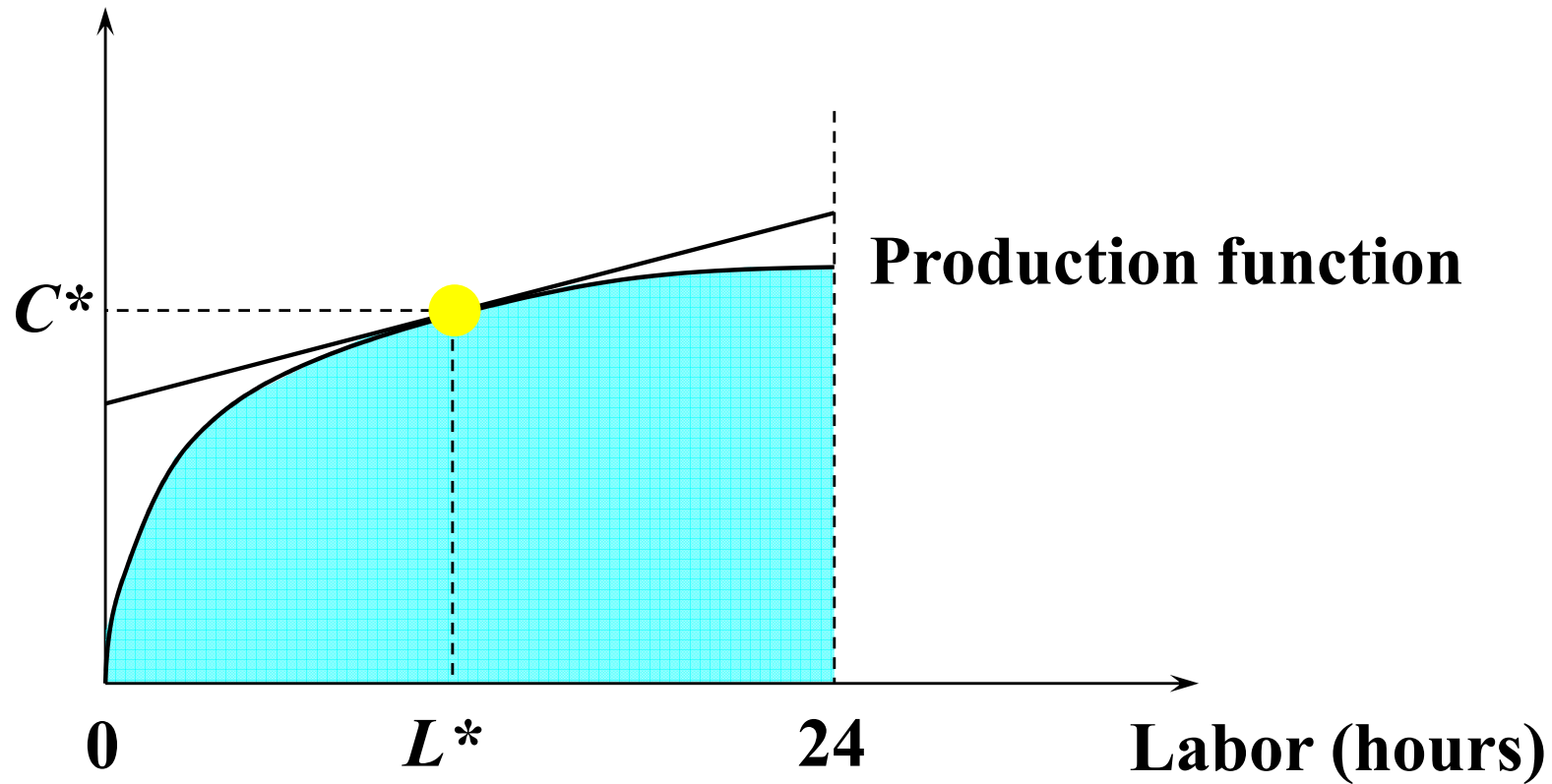
Profit-Maximization

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Profit-Maximization

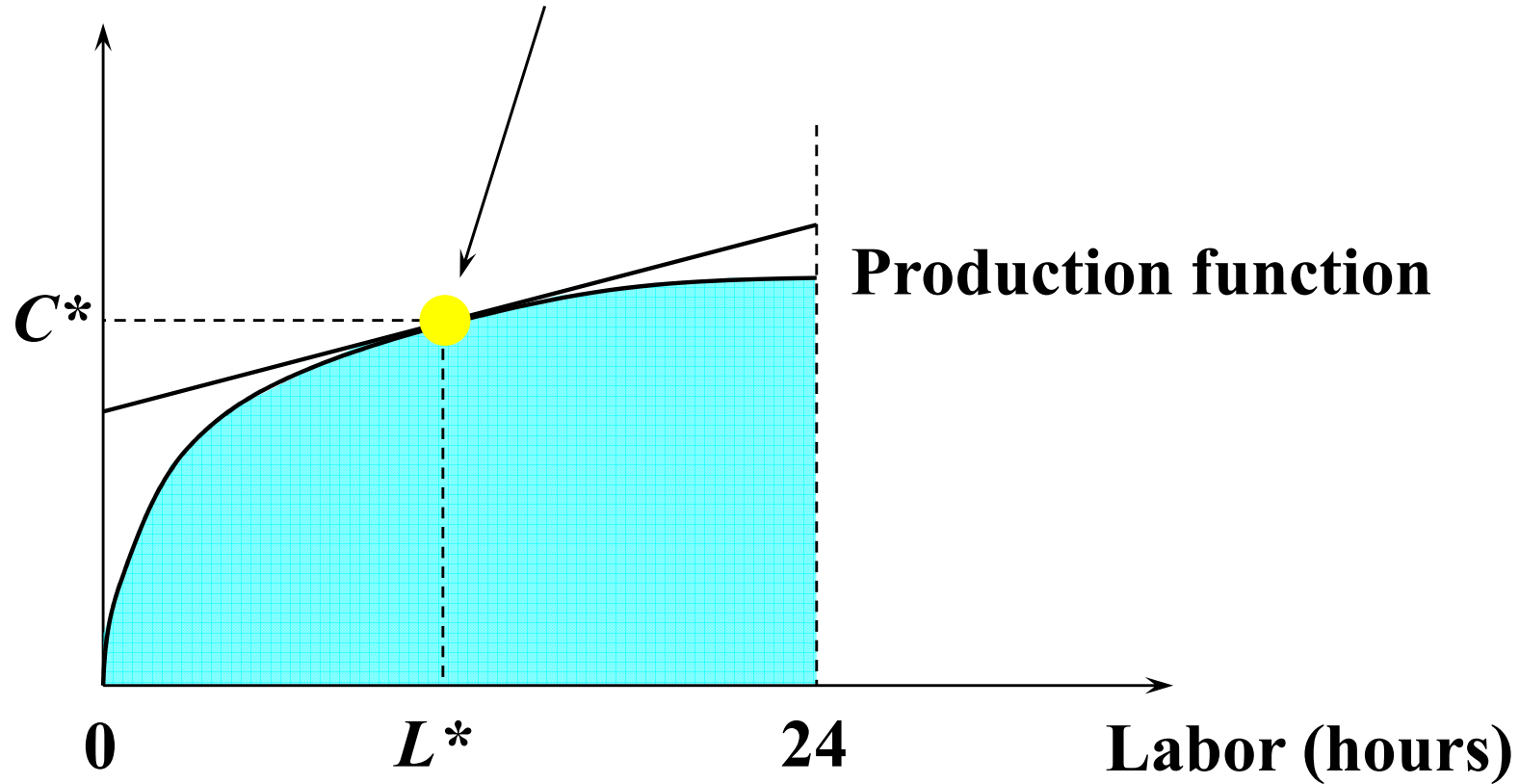
Coconuts



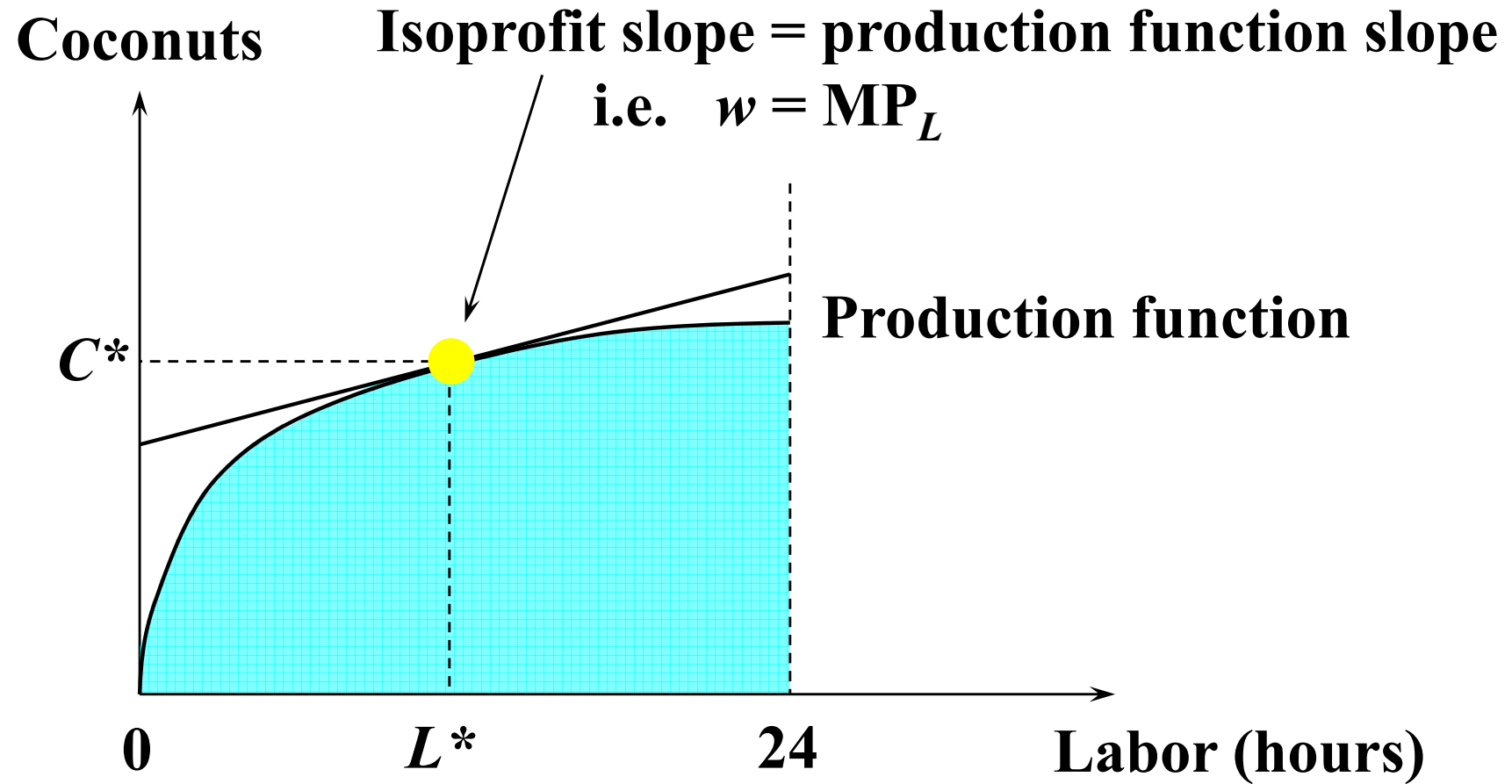
Profit-Maximization

Coconuts

Isoprofit slope = production function slope



Profit-Maximization

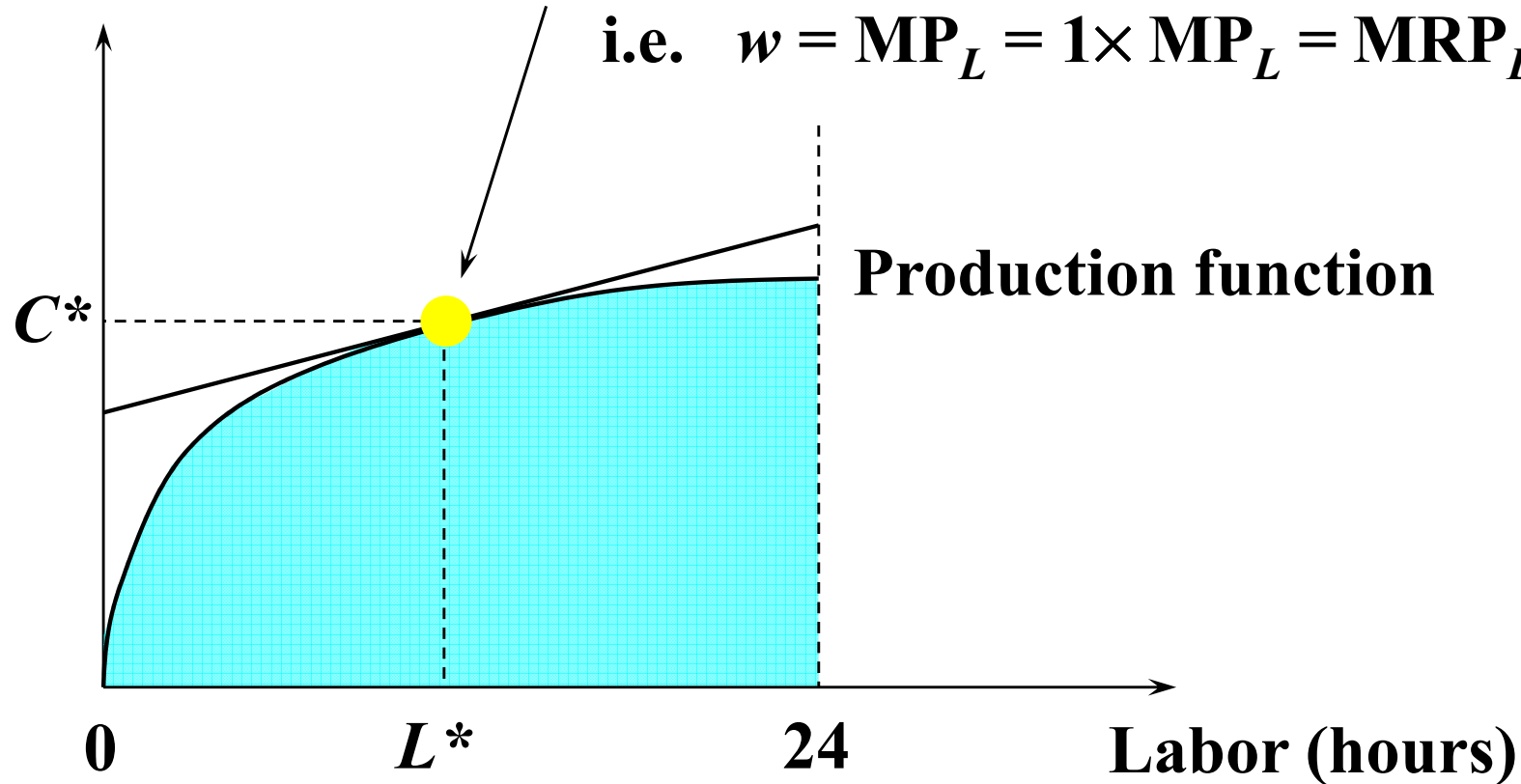


Profit-Maximization

Coconuts

Isoprofit slope = production function slope

i.e. $w = MP_L = 1 \times MP_L = MRP_L$.

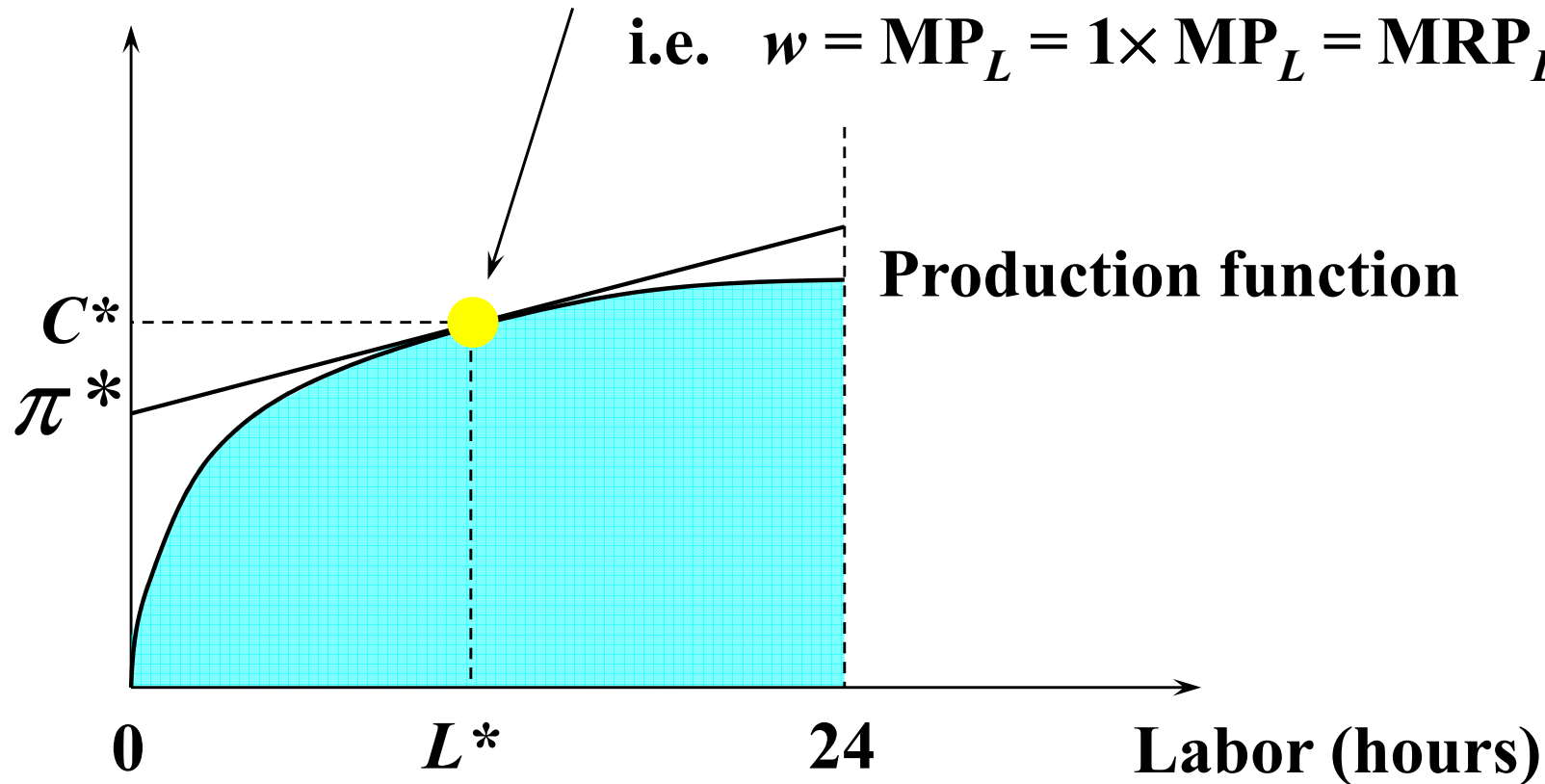


Profit-Maximization

Coconuts

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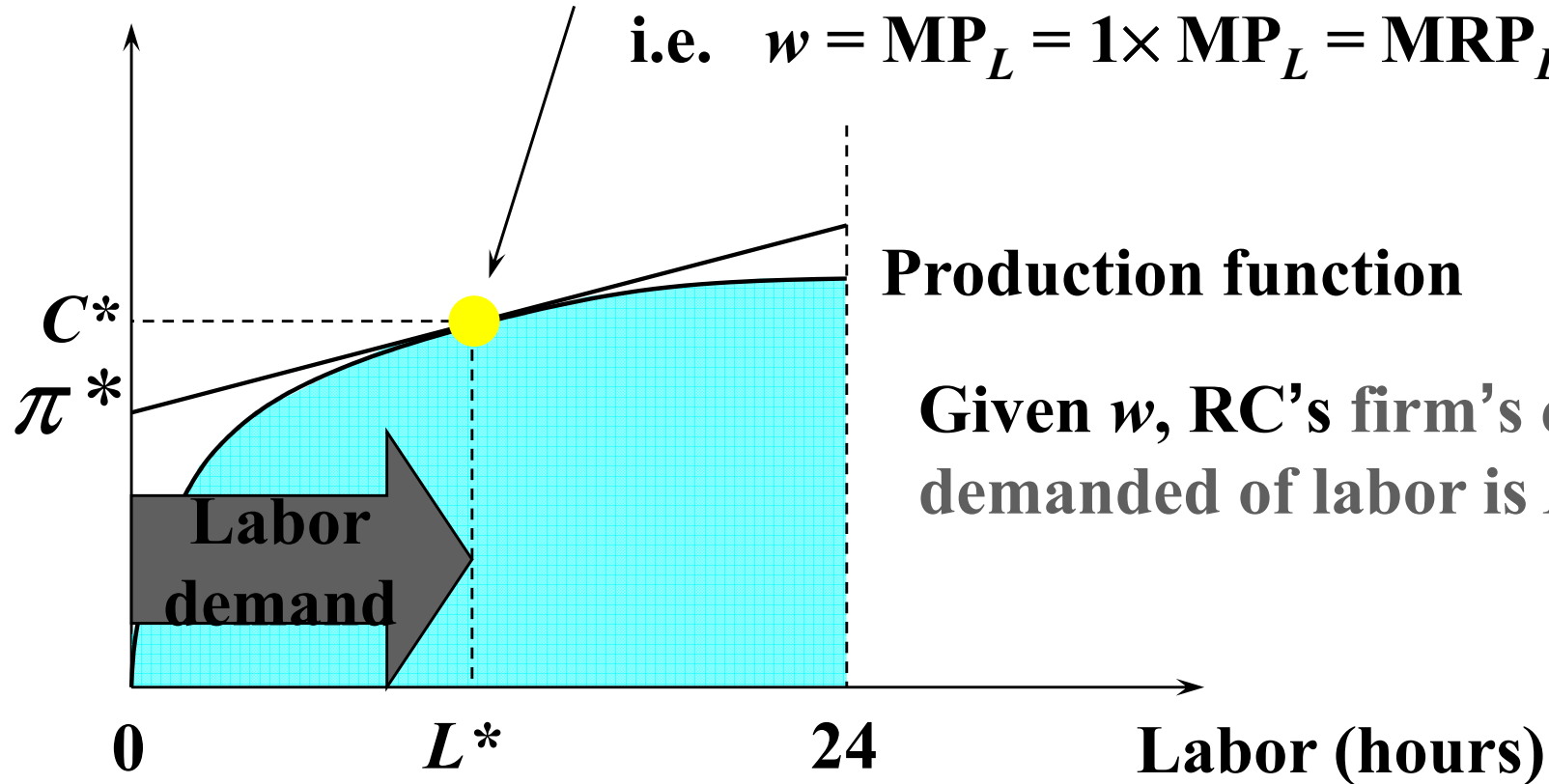
RC gets $\pi^* = C^* - wL^*$

Profit-Maximization

Coconuts

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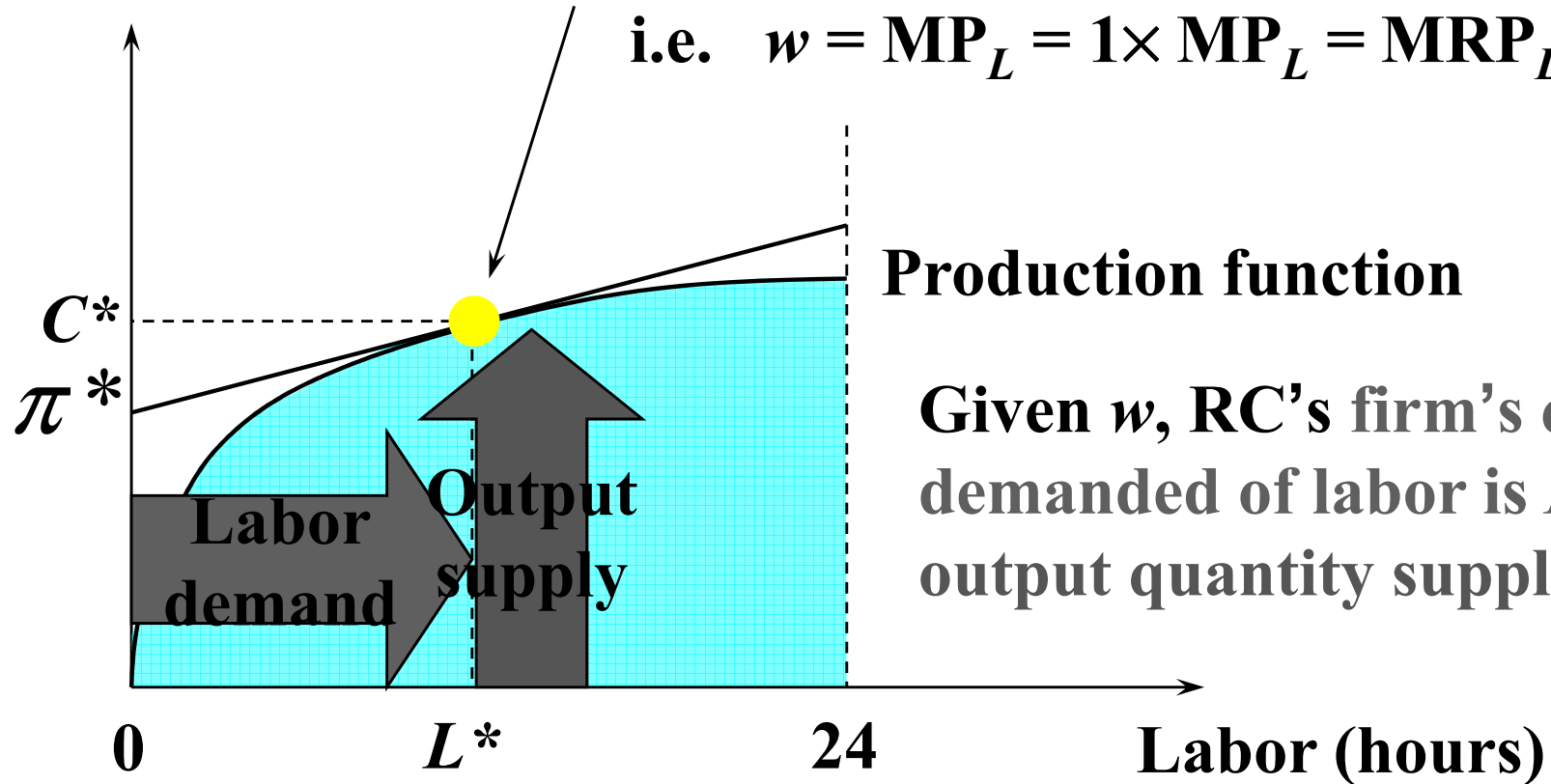
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Profit-Maximization

Coconuts

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Production function

Given w , RC's firm's quantity demanded of labor is L^* and output quantity supplied is C^* .

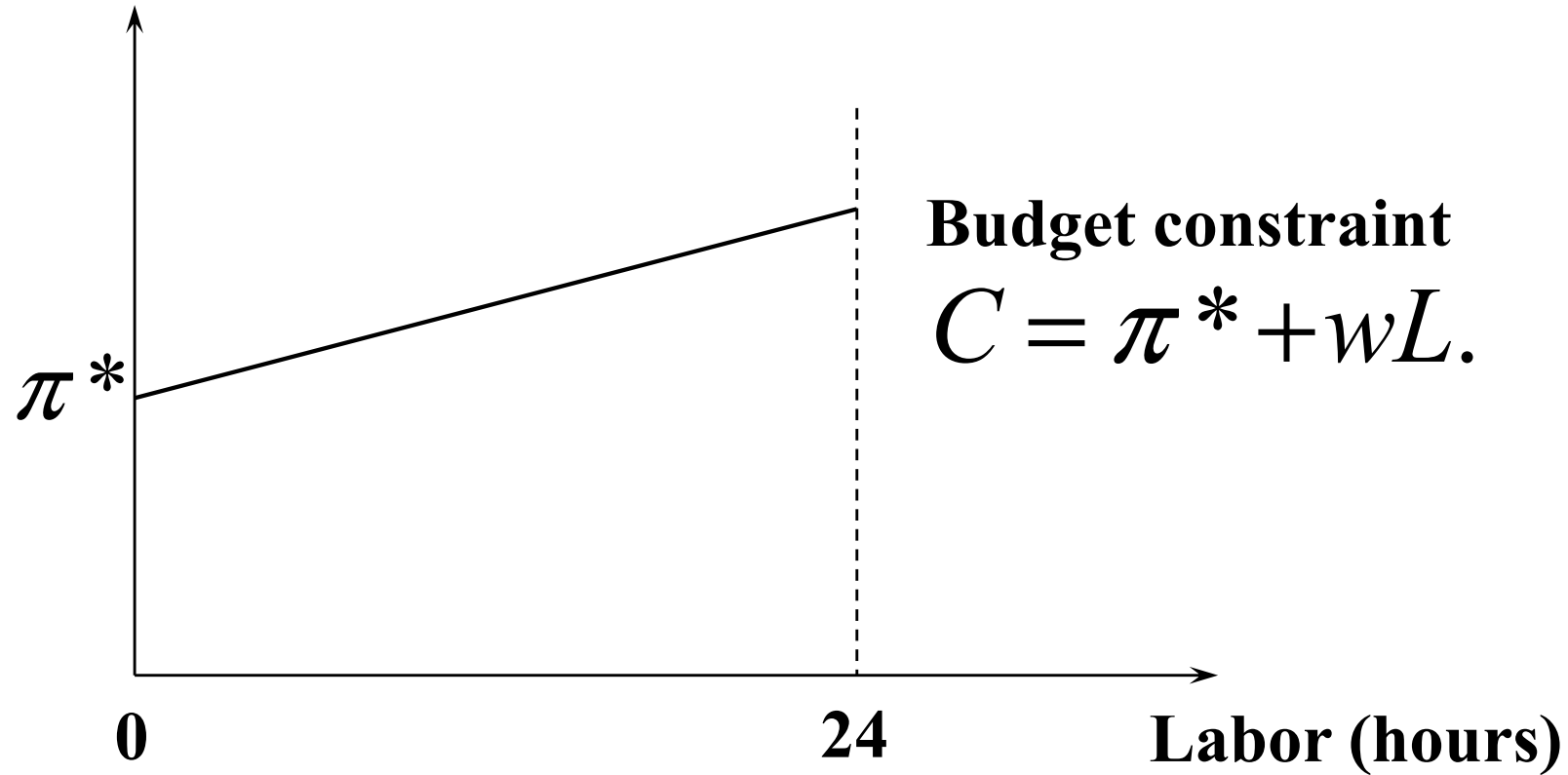
RC gets $\pi^* = C^* - wL^*$

Utility-Maximization

- ◆ **Now consider RC as a consumer endowed with π^* who can work for w per hour.**
- ◆ **What is RC's most preferred consumption bundle?**
- ◆ **Budget constraint is $C = \pi^* + wL$.**

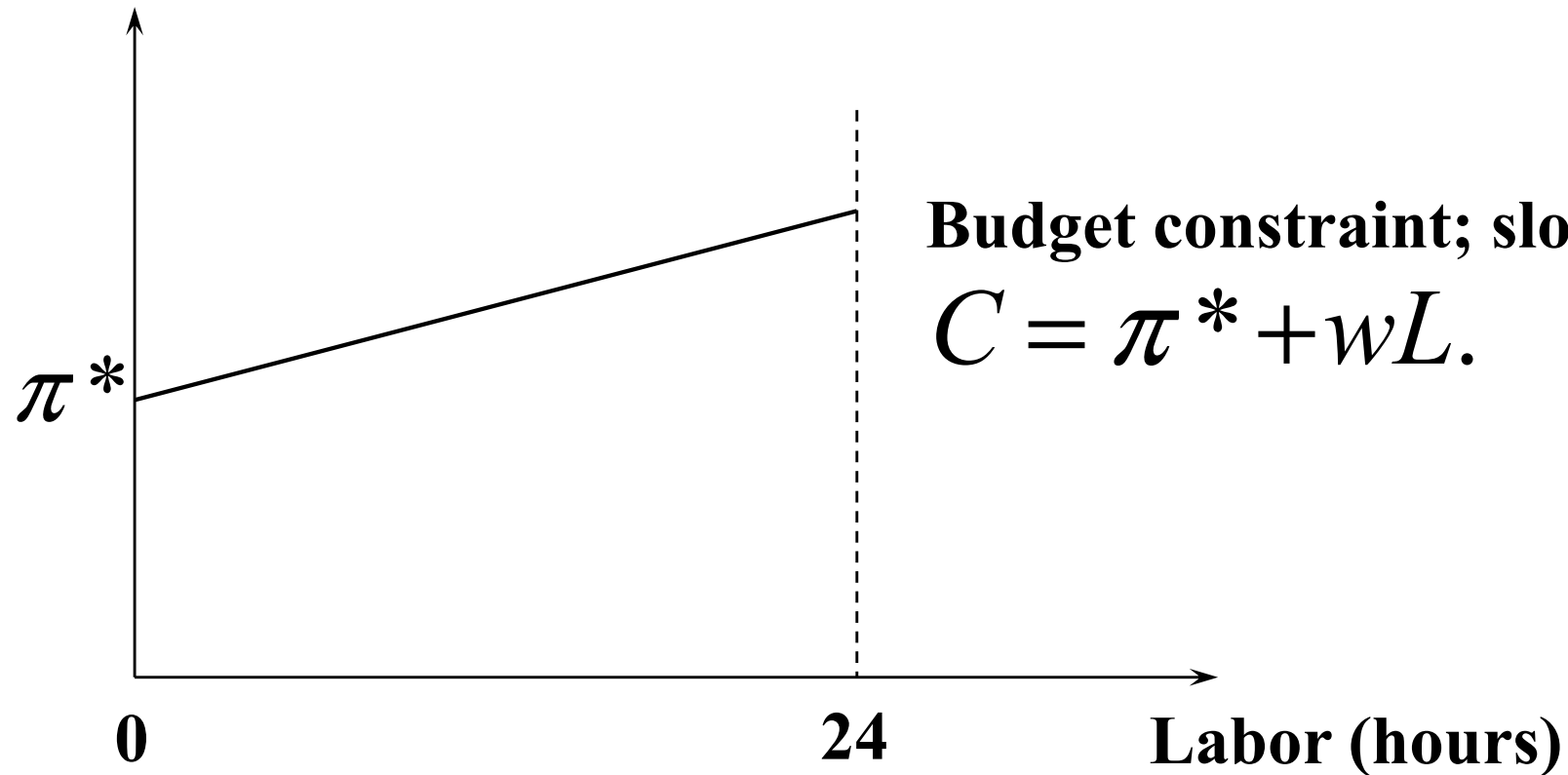
Utility-Maximization

Coconuts



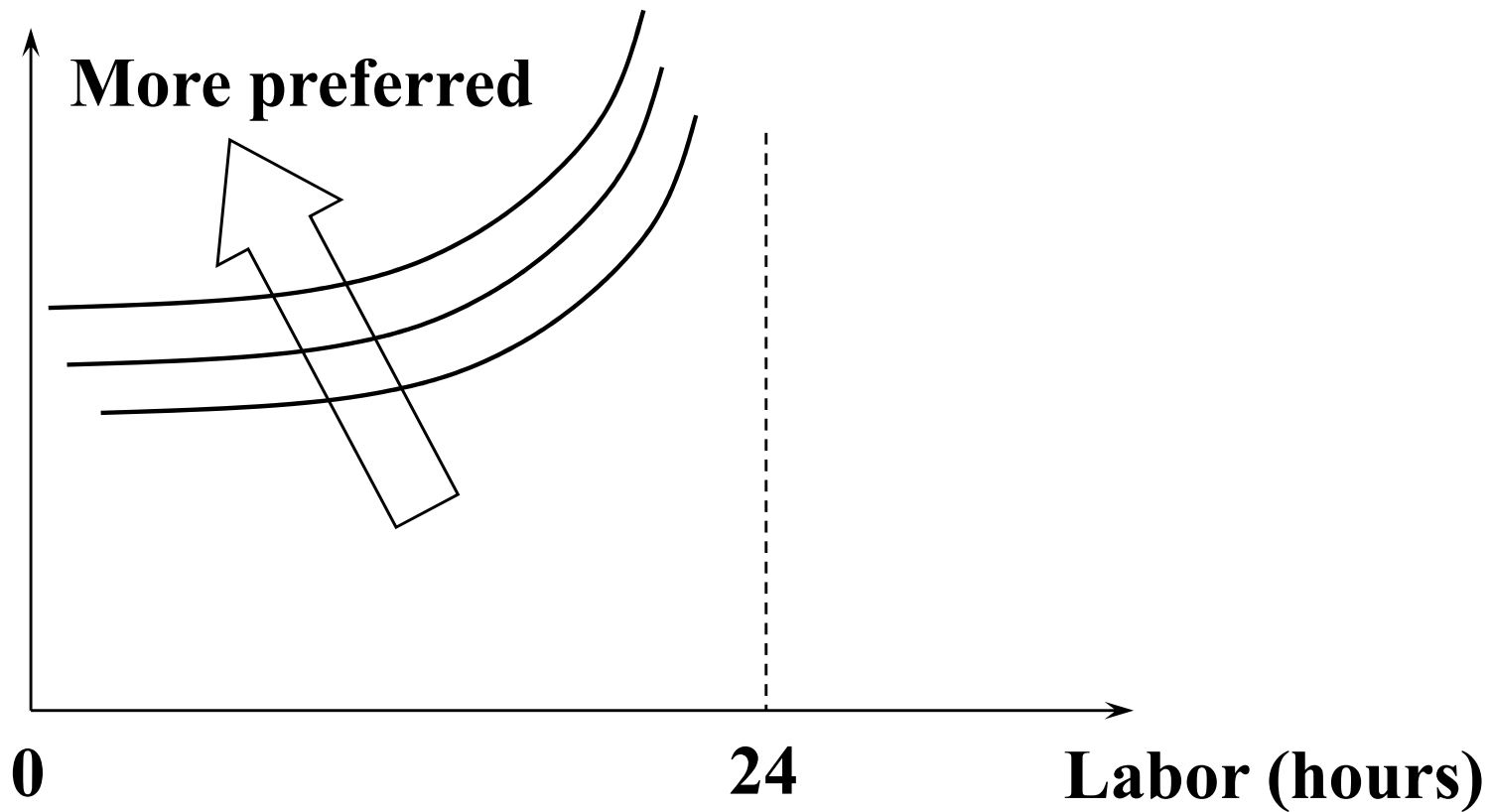
Utility-Maximization

Coconuts



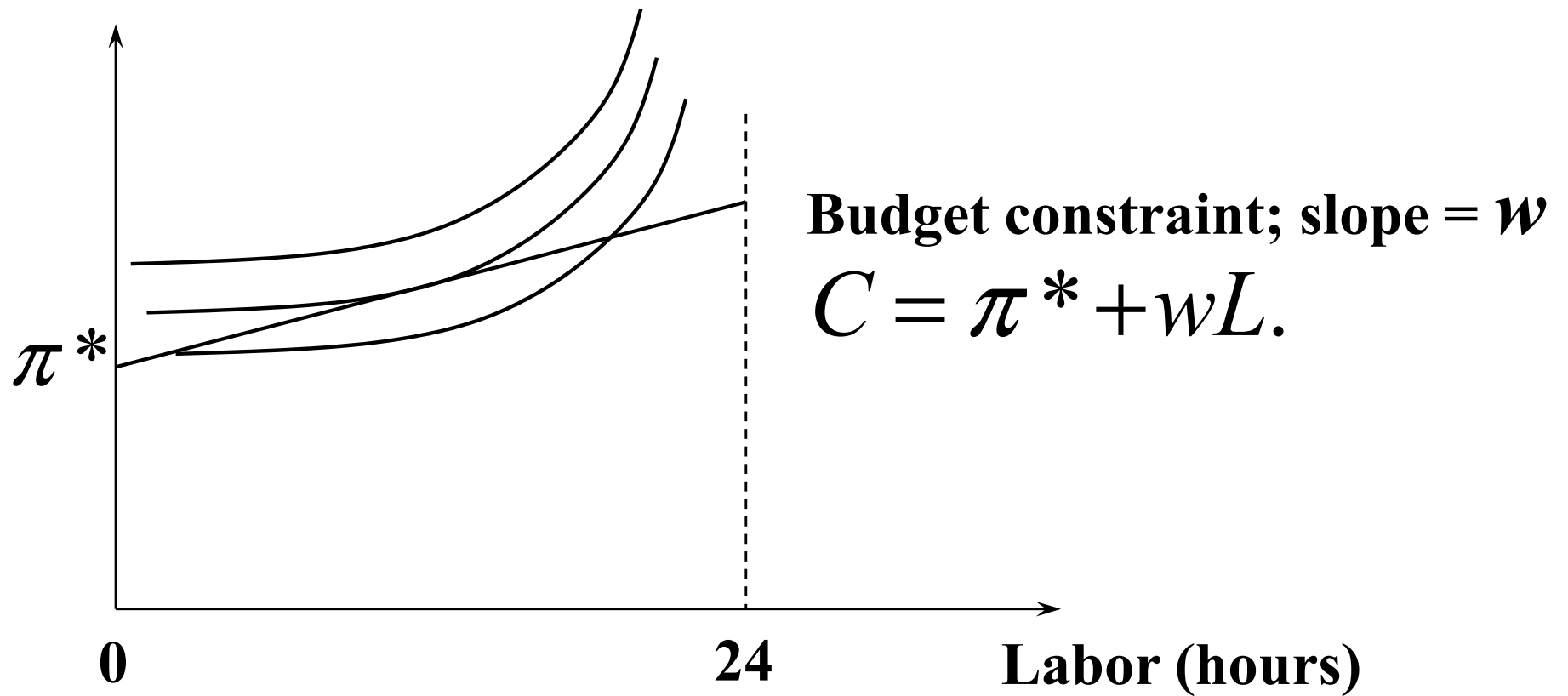
Utility-Maximization

Coconuts



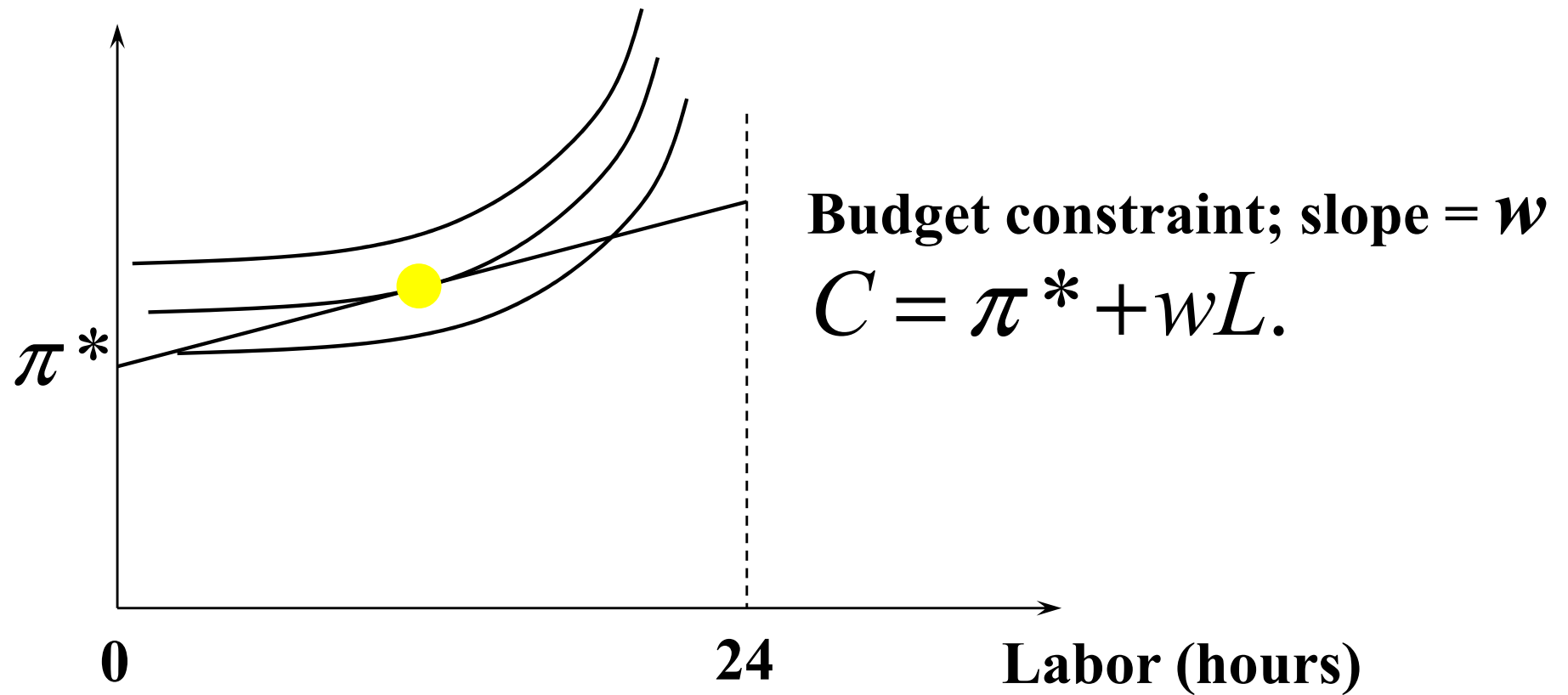
Utility-Maximization

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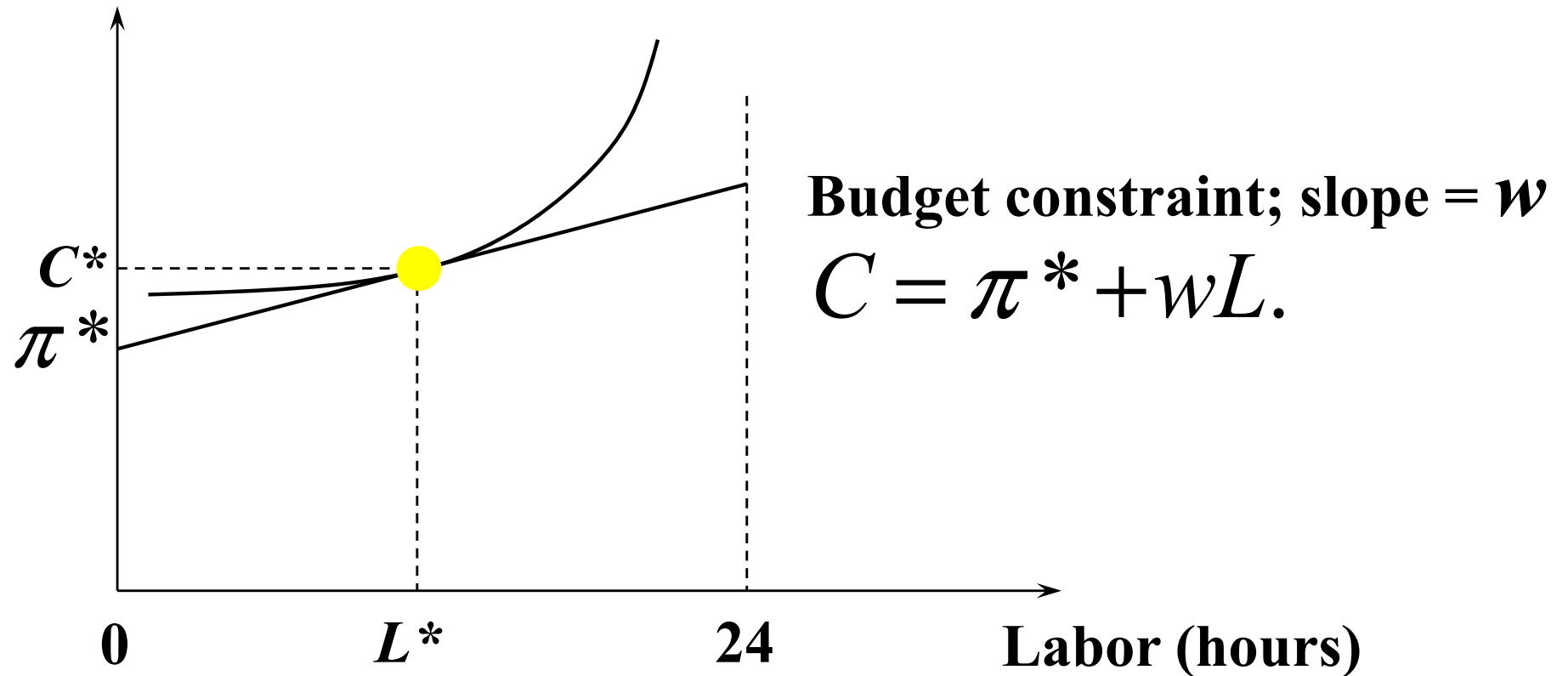
Utility-Maximization

Coconuts



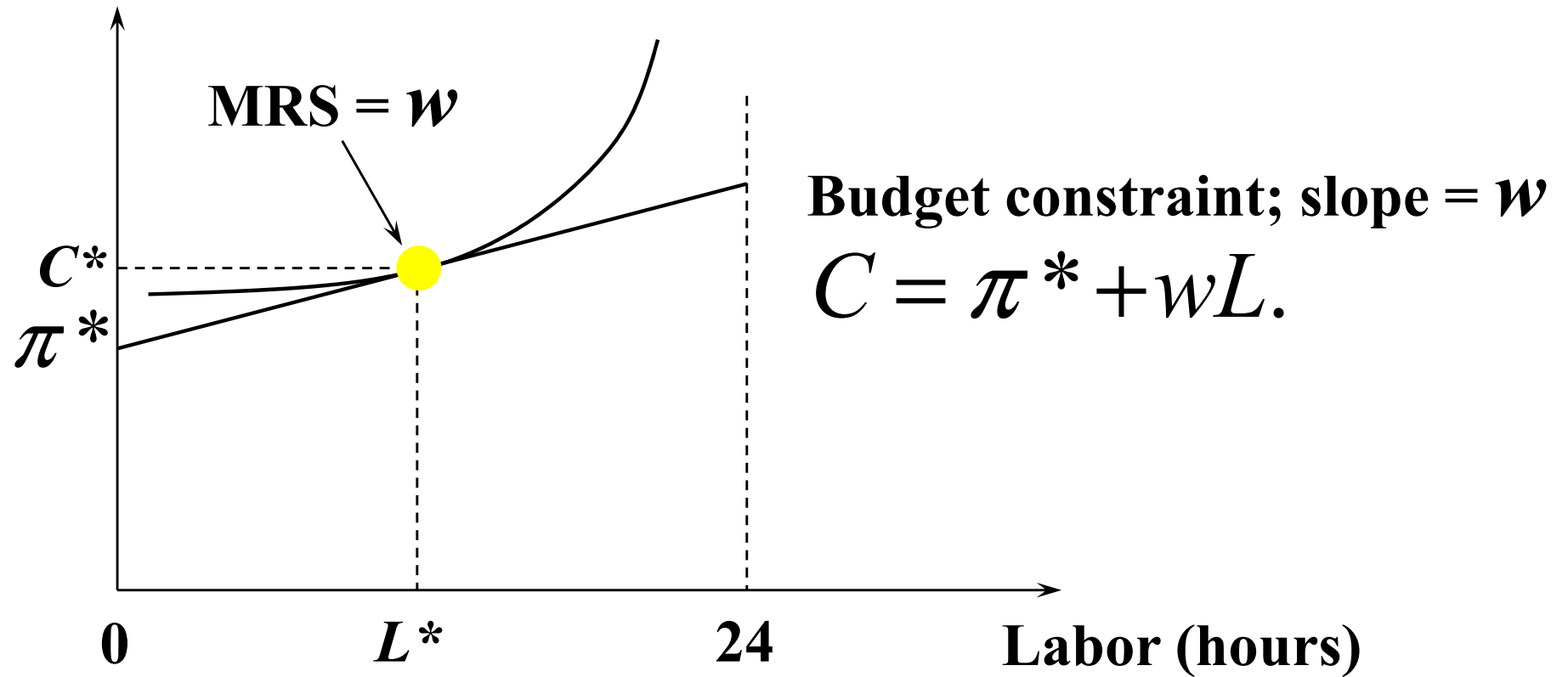
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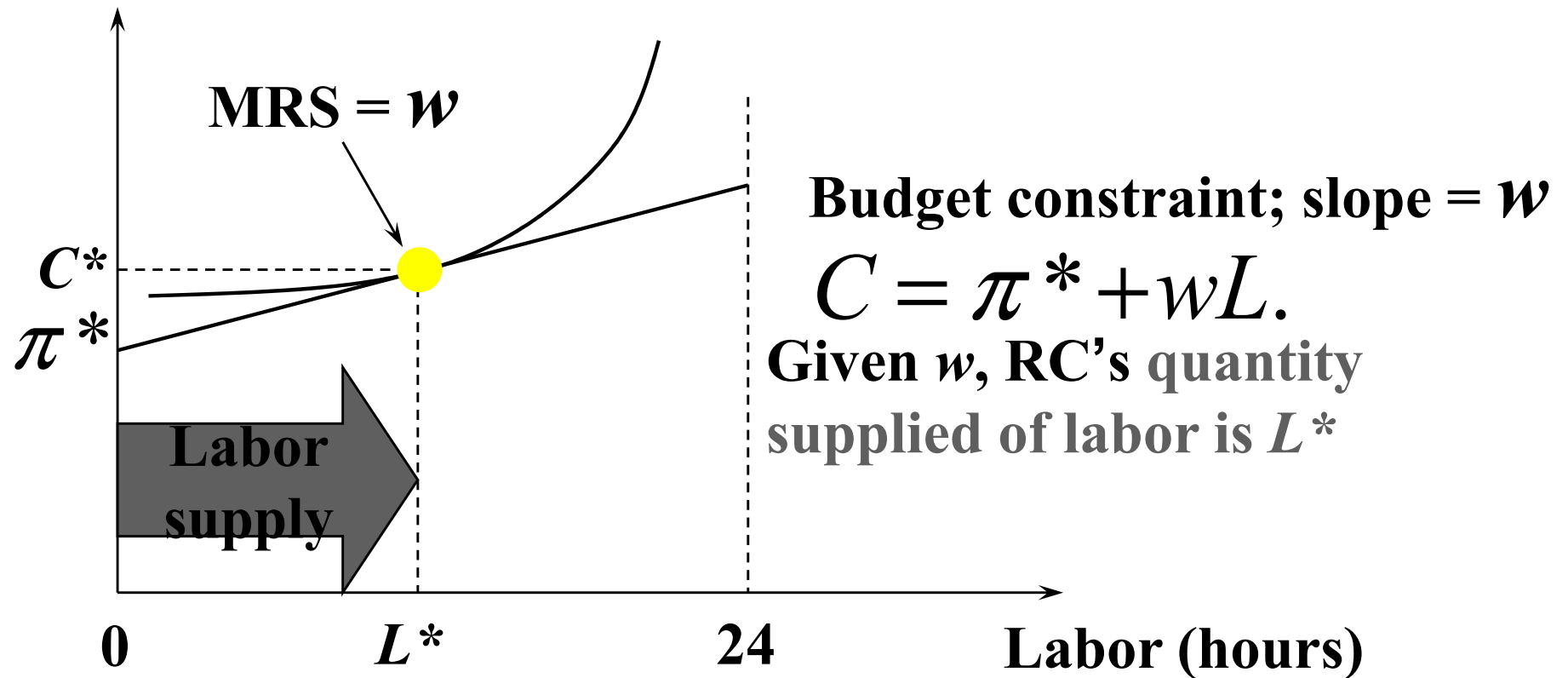
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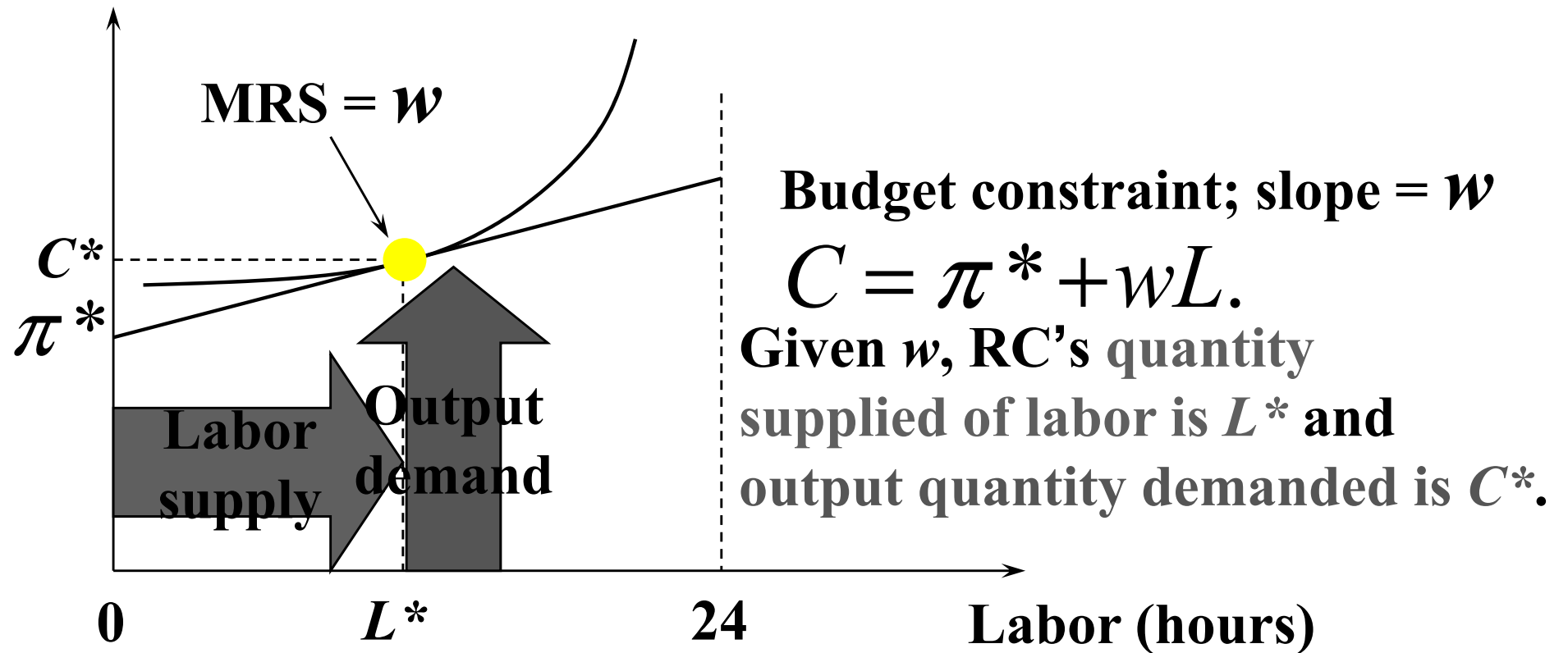
Utility-Maximization

Coconuts



Utility-Maximization

Coconuts



Utility-Maximization & Profit-Maximization

◆ Profit-maximization:

– $w = MP_L$

– quantity of output supplied = C^*

– quantity of labor demanded = L^*

Utility-Maximization & Profit-Maximization

◆ Profit-maximization:

– $w = MP_L$

– quantity of output supplied = C^*

– quantity of labor demanded = L^*

◆ Utility-maximization:

– $w = MRS$

– quantity of output demanded = C^*

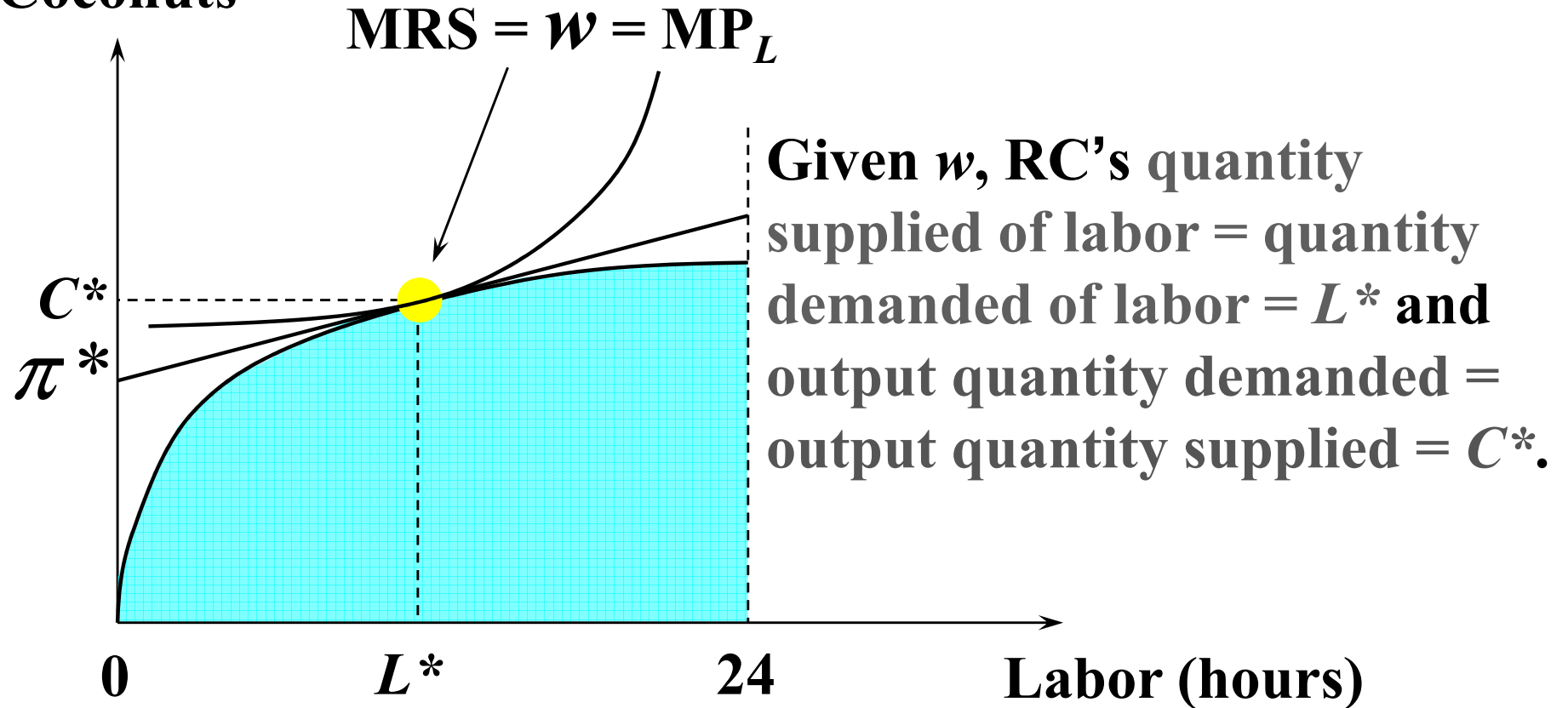
– quantity of labor supplied = L^*

Utility-Maximization & Profit-Maximization

- ◆ **Profit-maximization:** **Coconut and labor markets both clear.**
 - $w = MP_L$
 - quantity of output supplied = C^*
 - quantity of labor demanded = L^*
- ◆ **Utility-maximization:**
 - $w = MRS$
 - quantity of output demanded = C^*
 - quantity of labor supplied = L^*

Utility-Maximization & Profit-Maximization

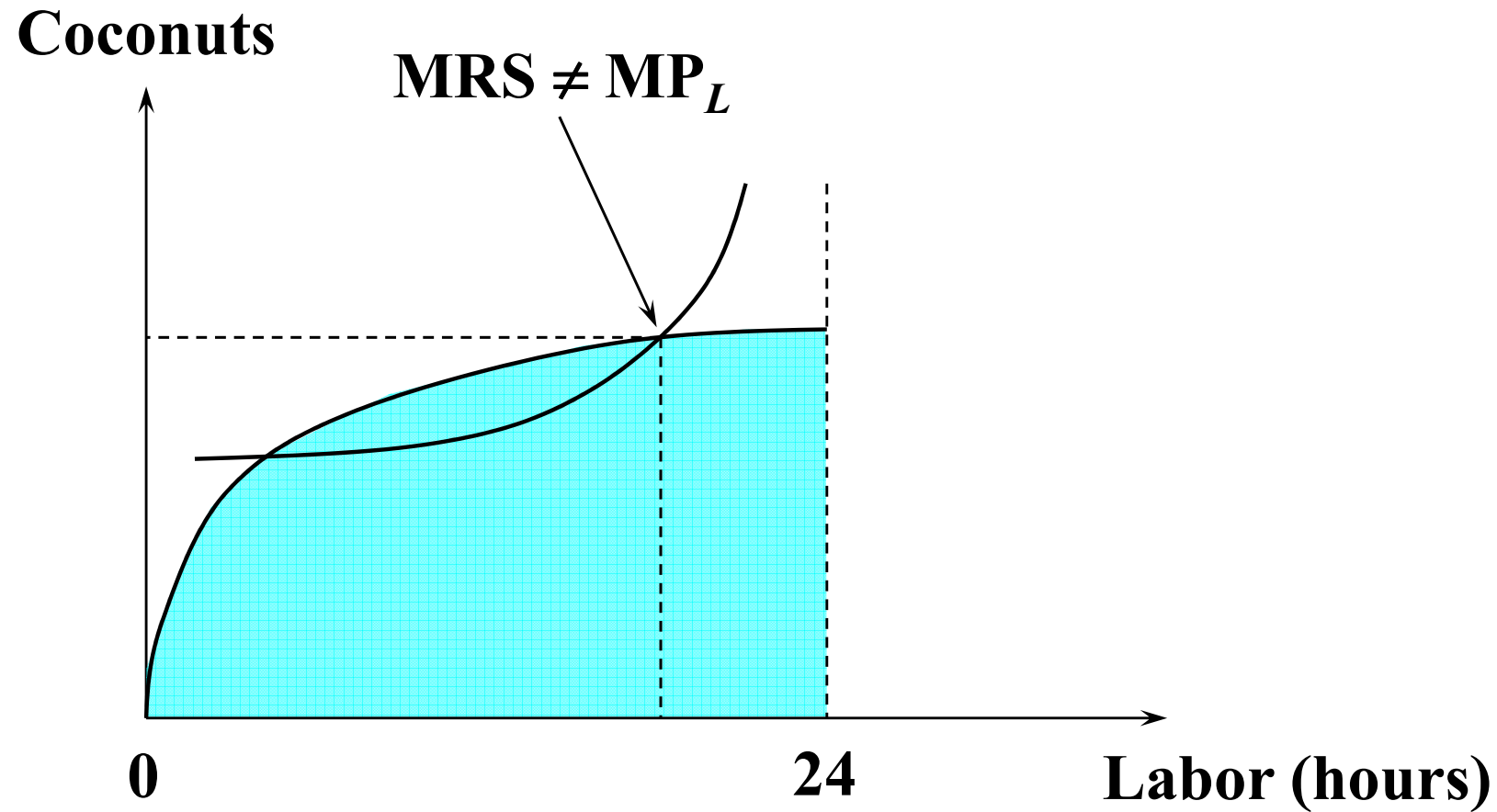
Coconuts



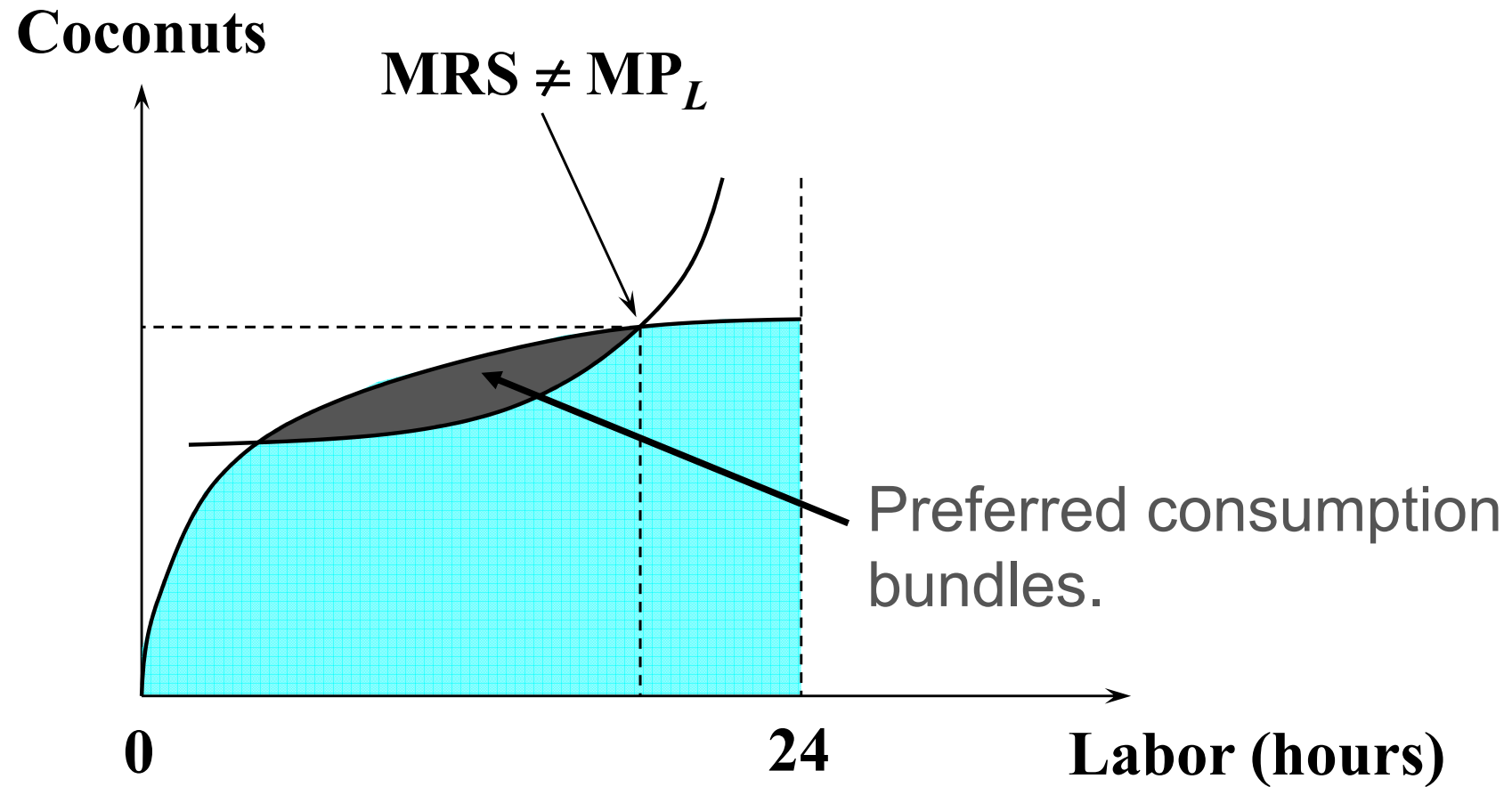
Pareto Efficiency

◆ **Must have $MRS = MP_L$.**

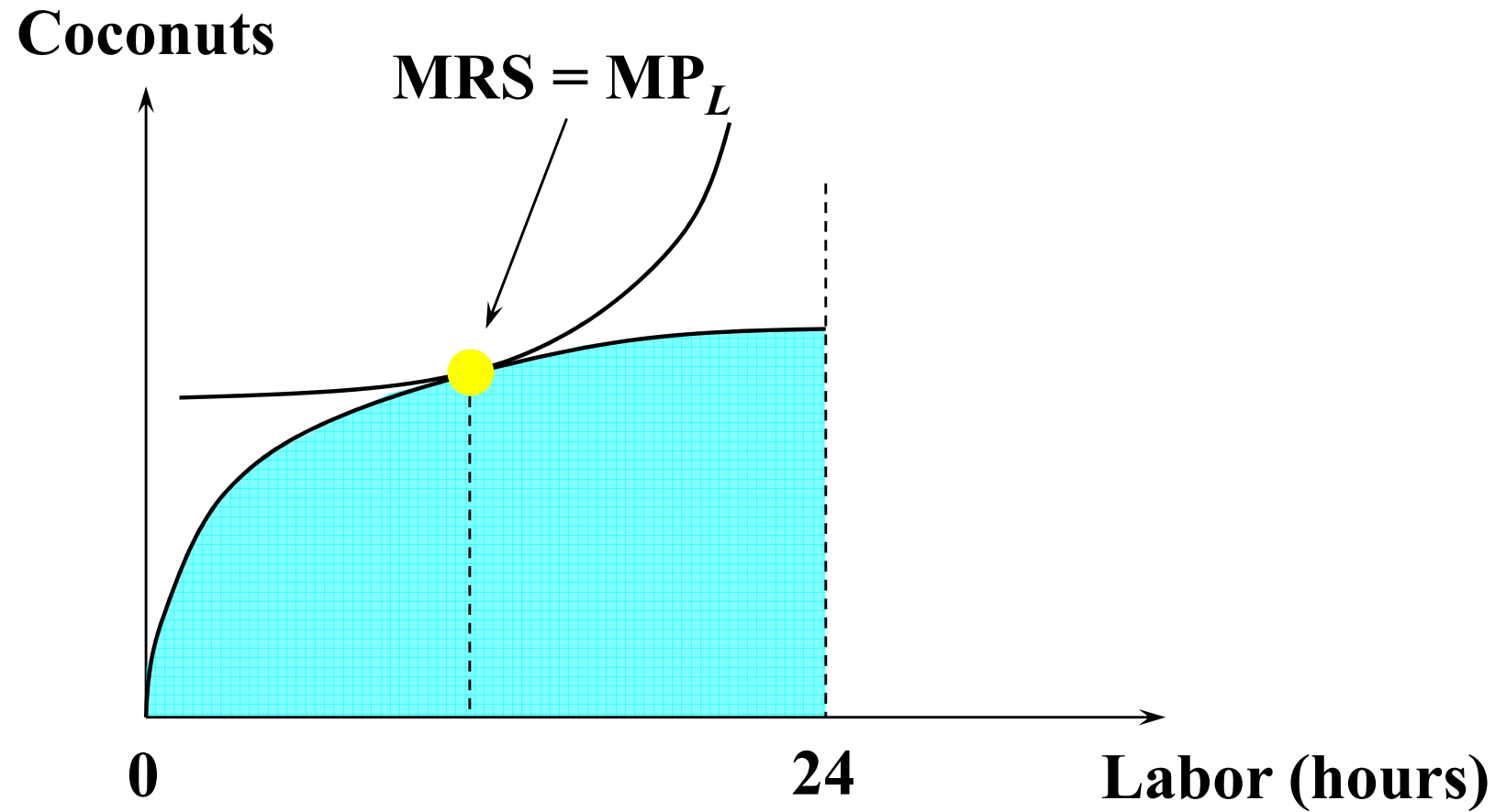
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Pareto Efficiency

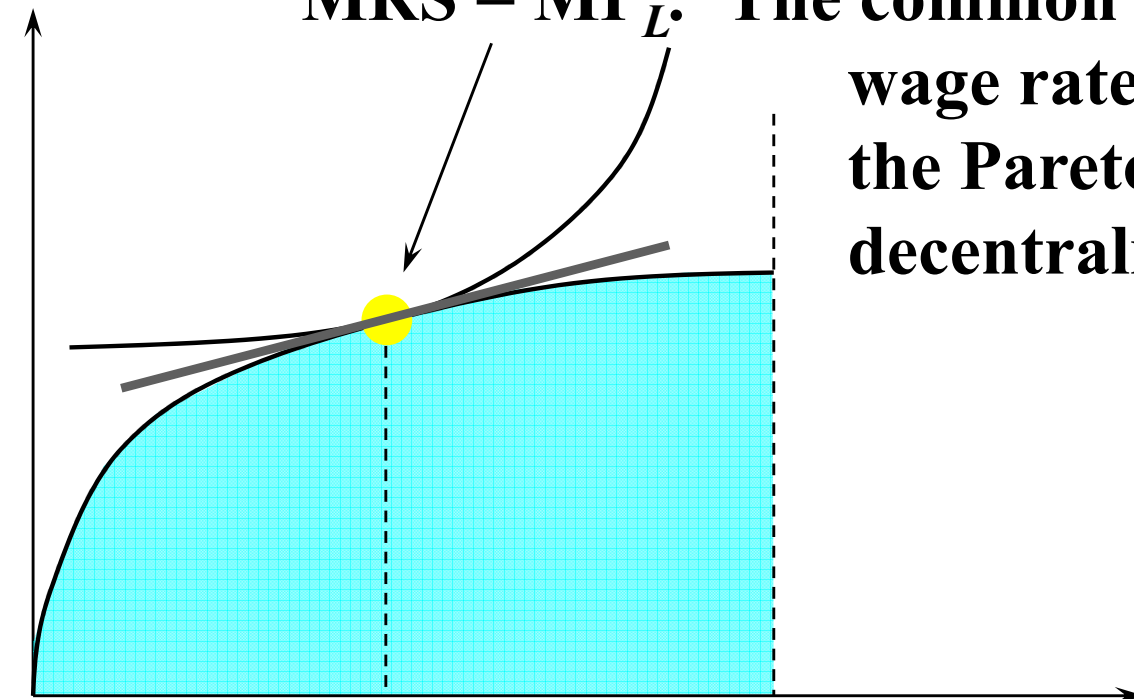


Pareto Efficiency



Pareto Efficiency

Coconuts



$MRS = MP_L$. The common slope \Rightarrow relative wage rate w that implements the Pareto efficient plan by decentralized pricing.

0

24

Labor (hours)

First Fundamental Theorem of Welfare Economics

- ◆ **A competitive market equilibrium is Pareto efficient if**
 - **consumers' preferences are convex**
 - **there are no externalities in consumption or production.**

Second Fundamental Theorem of Welfare Economics

- ◆ **Any Pareto efficient economic state can be achieved as a competitive market equilibrium if**
 - **consumers' preferences are convex**
 - **firms' technologies are convex**
 - **there are no externalities in consumption or production.**

Non-Convex Technologies

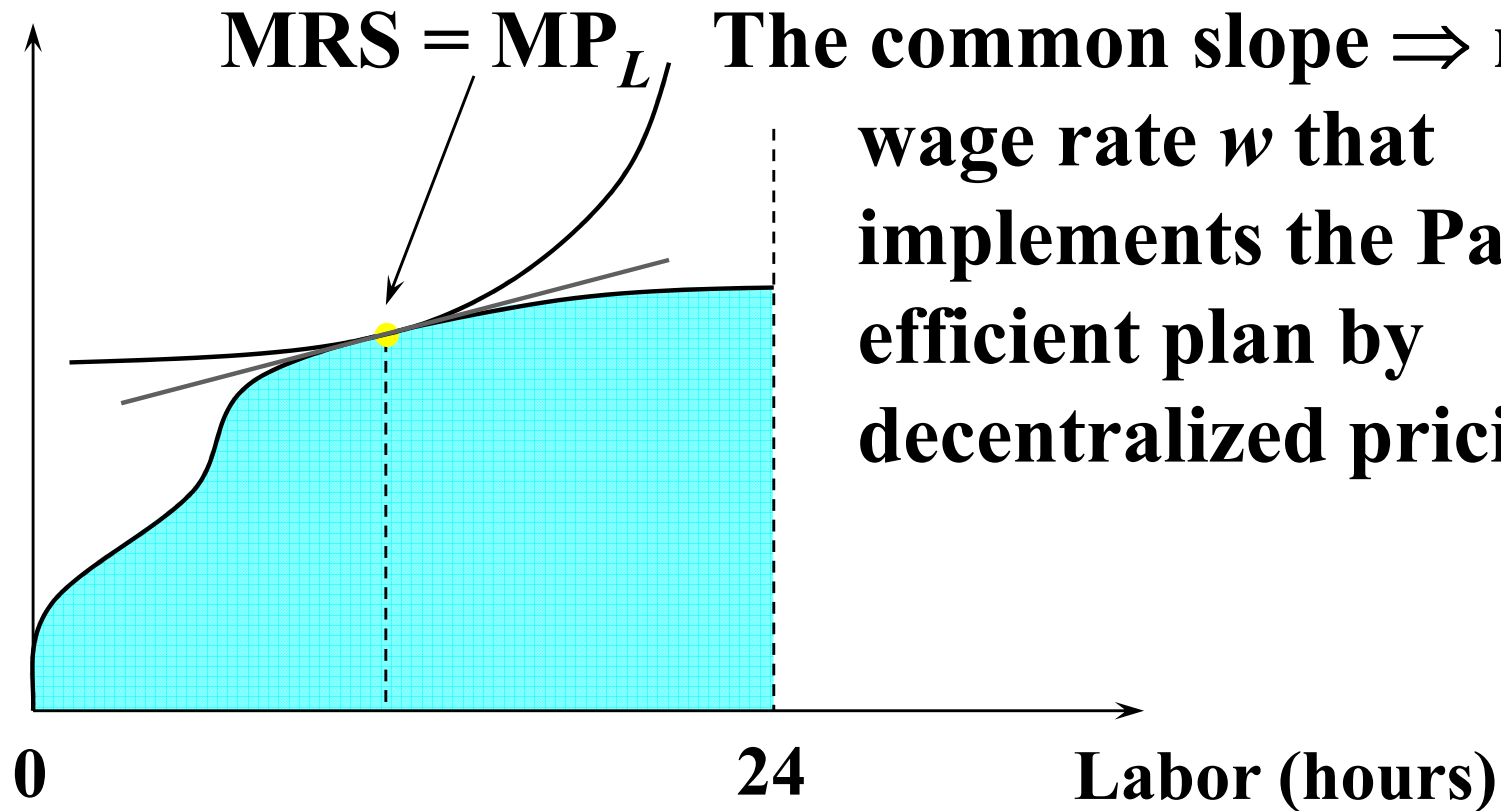
- ◆ **Do the Welfare Theorems hold if firms have non-convex technologies?**

Non-Convex Technologies

- ◆ **Do the Welfare Theorems hold if firms have non-convex technologies?**
- ◆ **The 1st Theorem does not rely upon firms' technologies being convex.**

Non-Convex Technologies

Coconuts

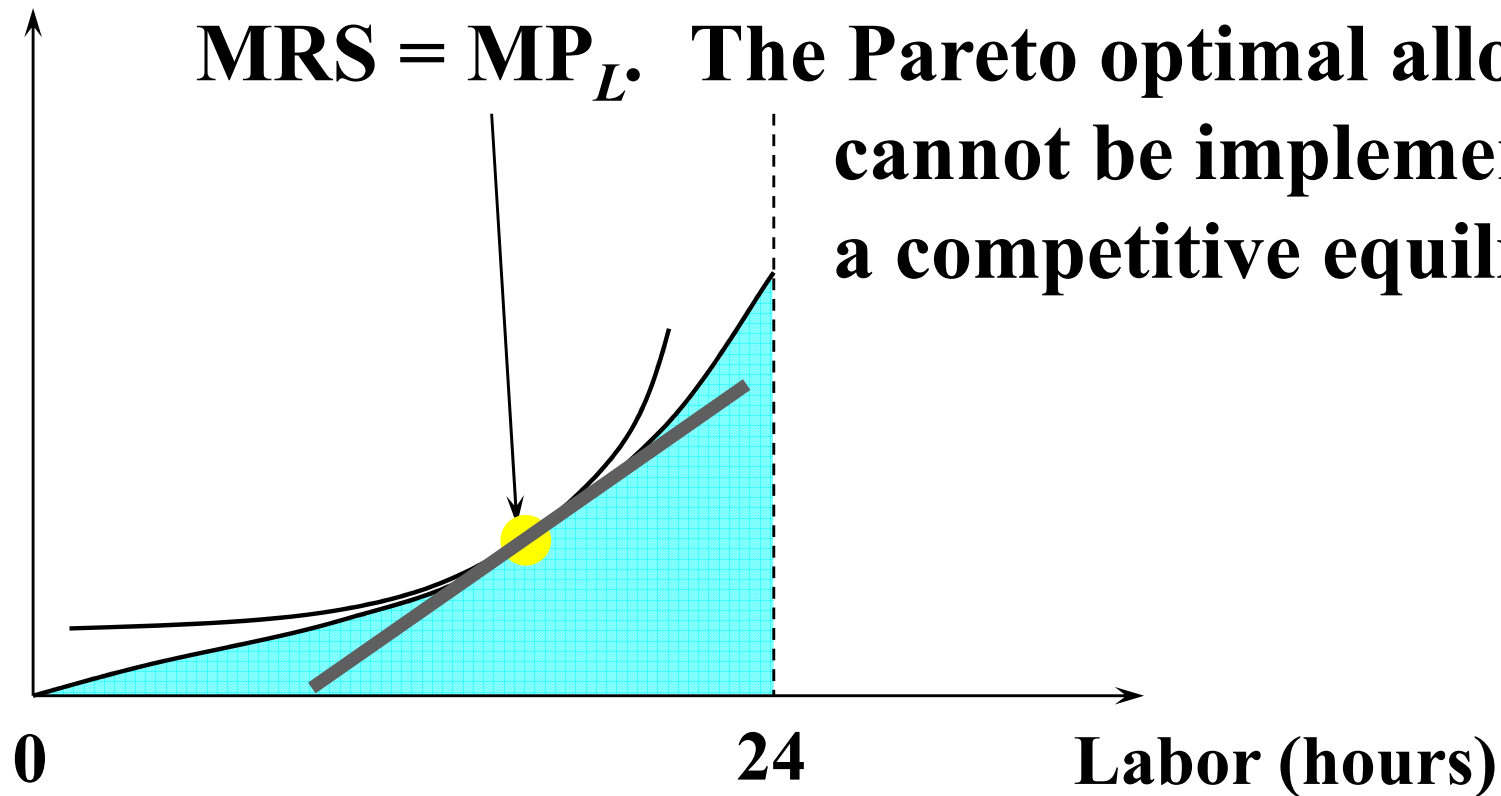


Non-Convex Technologies

- ◆ **Do the Welfare Theorems hold if firms have non-convex technologies?**
- ◆ **The 2nd Theorem does require that firms' technologies be convex.**

Non-Convex Technologies

Coconuts

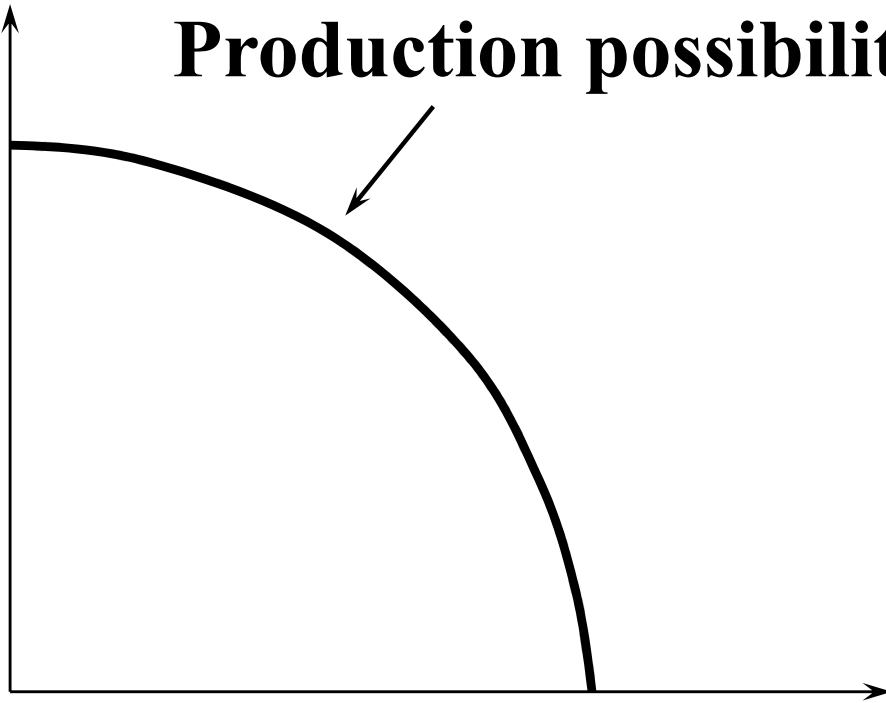


Production Possibilities

- ◆ **Resource and technological limitations restrict what an economy can produce.**
- ◆ **The set of all feasible output bundles is the economy's production possibility set.**
- ◆ **The set's outer boundary is the production possibility frontier.**

Production Possibilities

Coconuts

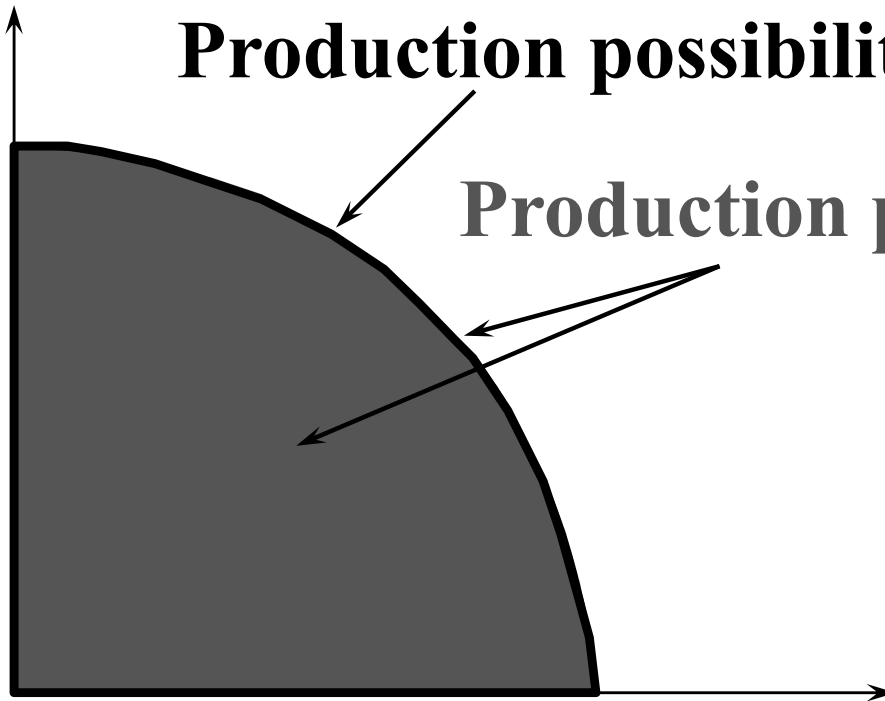


Production possibility frontier (ppf)

Fish

Production Possibilities

Coconuts



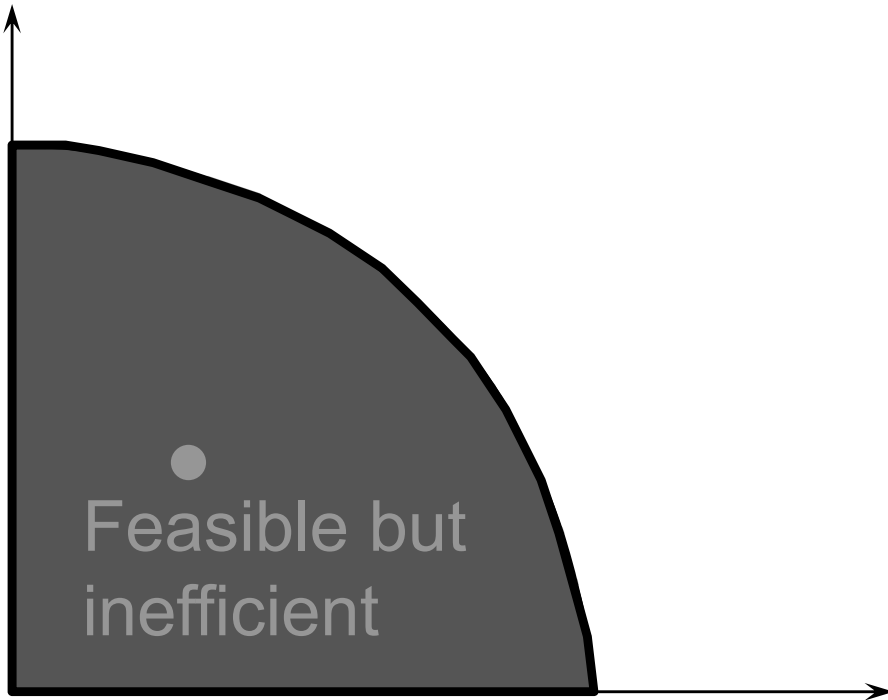
Production possibility frontier (ppf)

Production possibility set

Fish

Production Possibilities

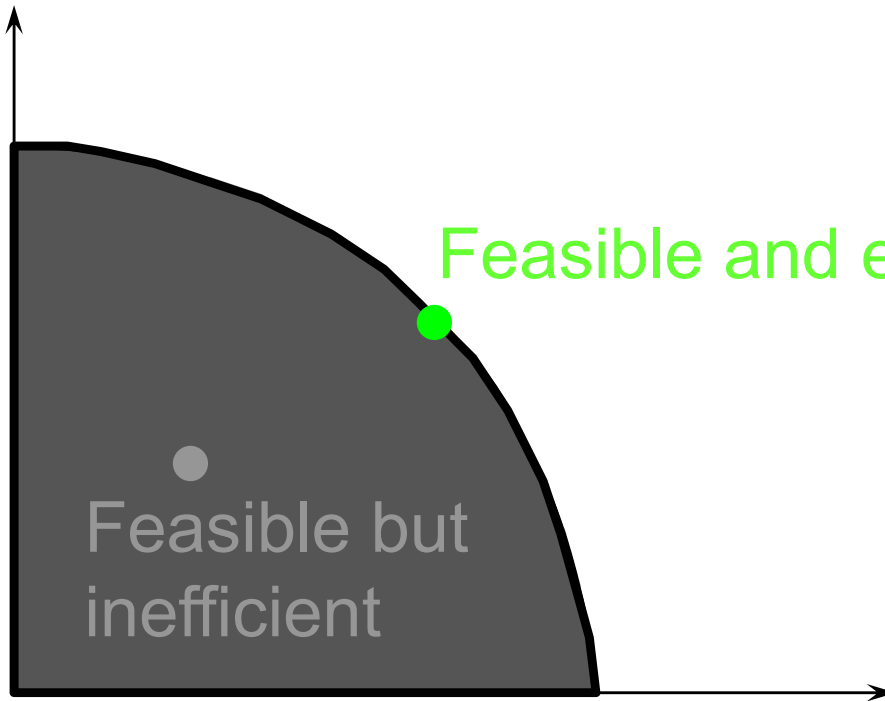
Coconuts



Fish

Production Possibilities

Coconuts



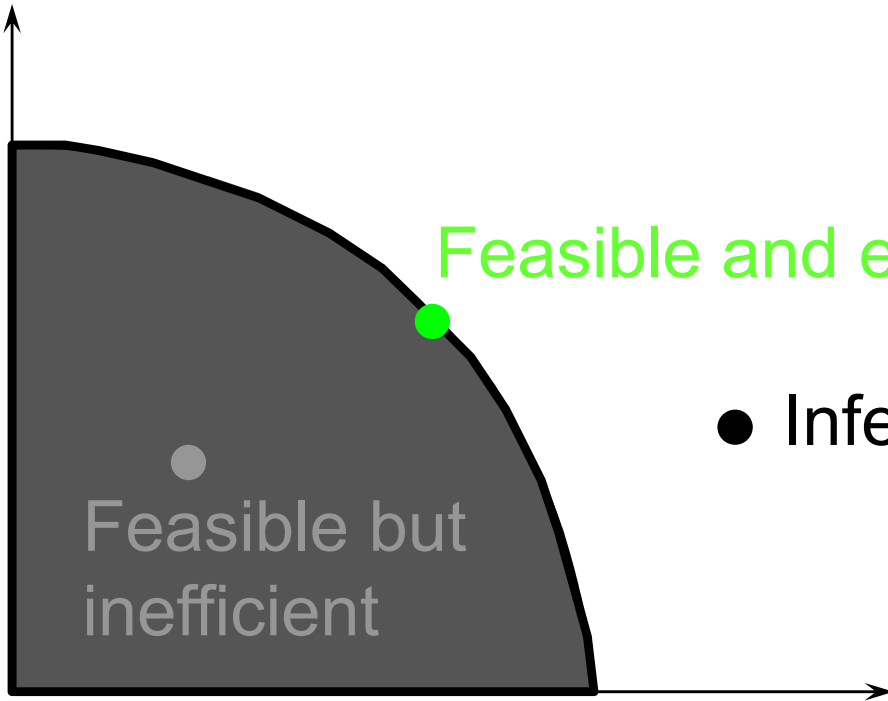
Feasible and efficient

Feasible but
inefficient

Fish

Production Possibilities

Coconuts



Feasible and efficient

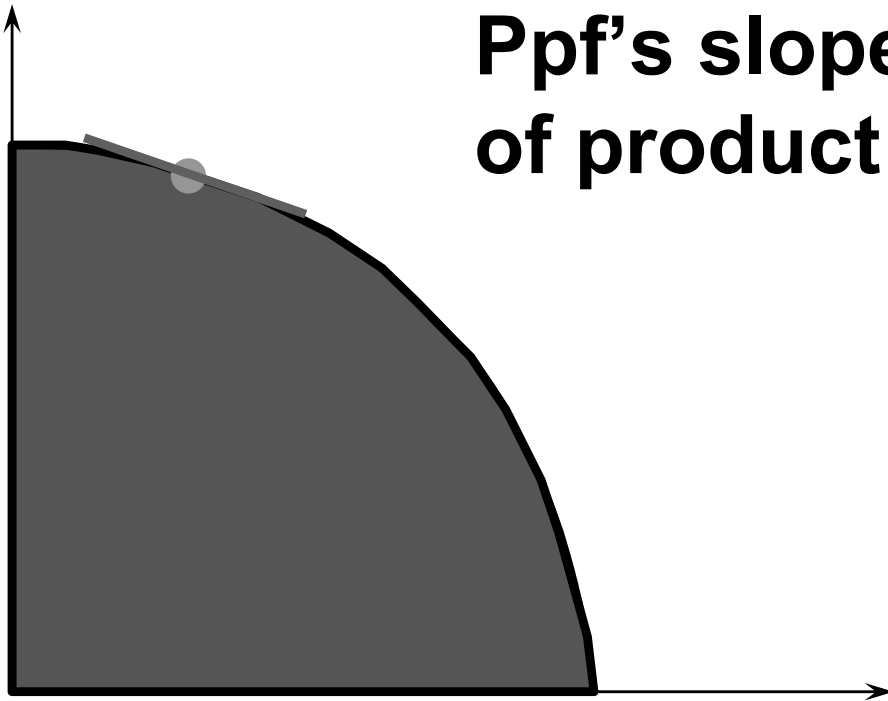
● Infeasible

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Production Possibilities

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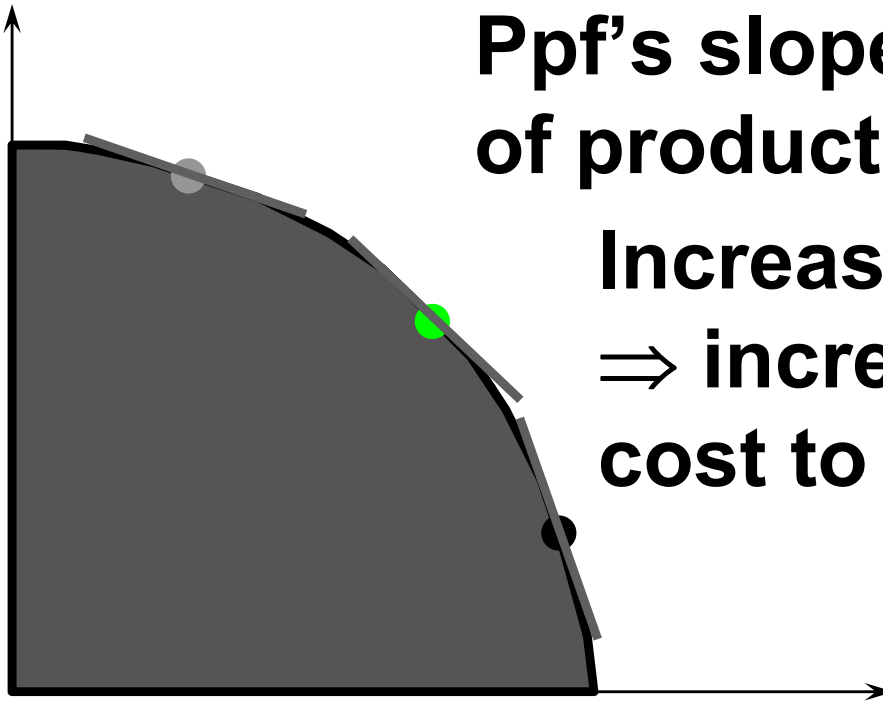


Ppf's slope is the marginal rate of product transformation.

Fish

Production Possibilities

Coconuts



Ppf's slope is the marginal rate of product transformation.

**Increasingly negative MRPT
⇒ increasing opportunity
cost to specialization.**

Fish

Production Possibilities

- ◆ **If there are no production externalities then a ppf will be concave w.r.t. the origin.**
- ◆ **Why?**

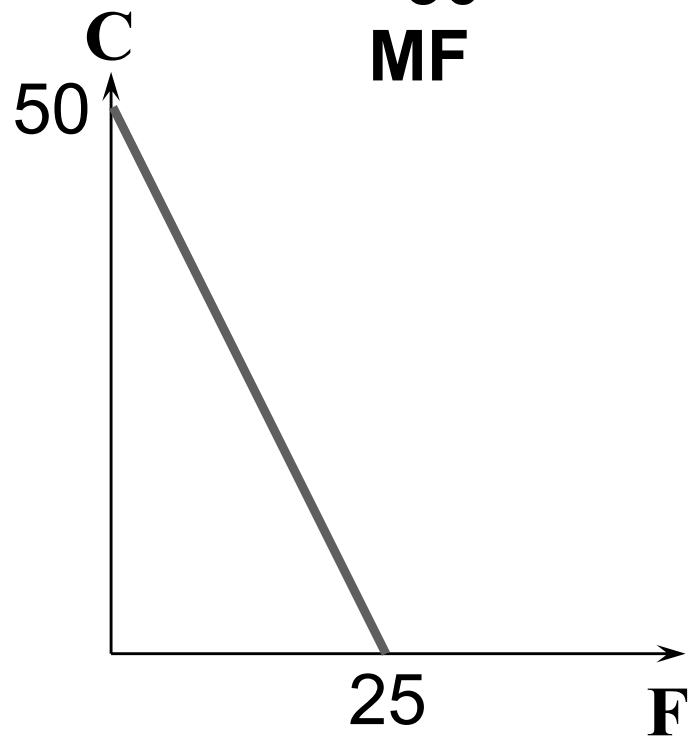
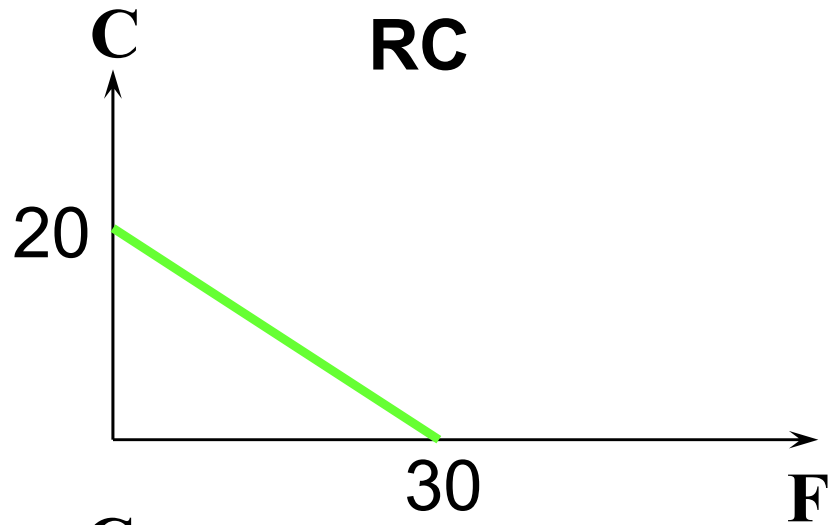
Production Possibilities

- ◆ **If there are no production externalities then a ppf will be concave w.r.t. the origin.**
- ◆ **Why?**
- ◆ **Because efficient production requires exploitation of comparative advantages.**

Comparative Advantage

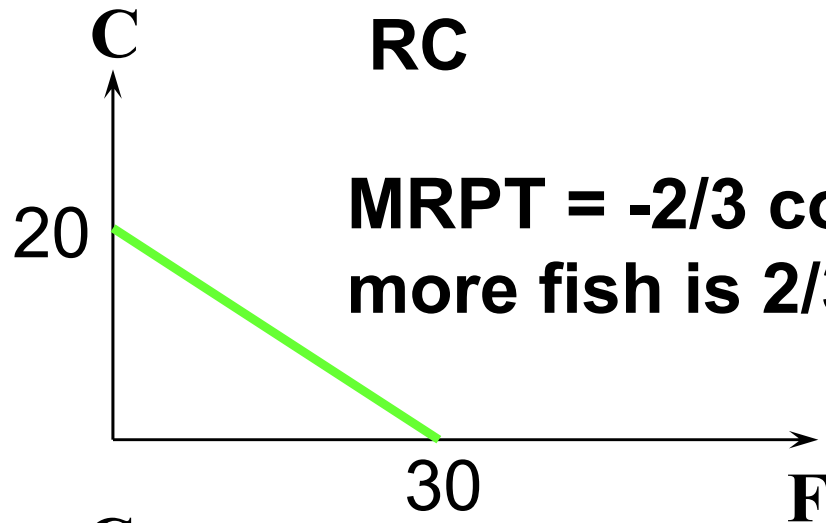
- ◆ **Two agents, RC and Man Friday (MF).**
- ◆ **RC can produce at most 20 coconuts or 30 fish.**
- ◆ **MF can produce at most 50 coconuts or 25 fish.**

Comparative Advantage

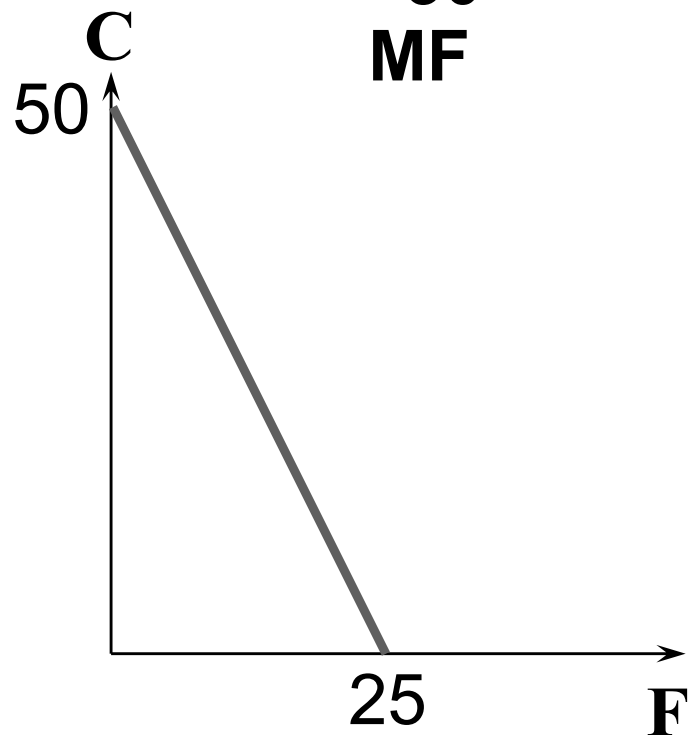


Comparative Advantage

RC

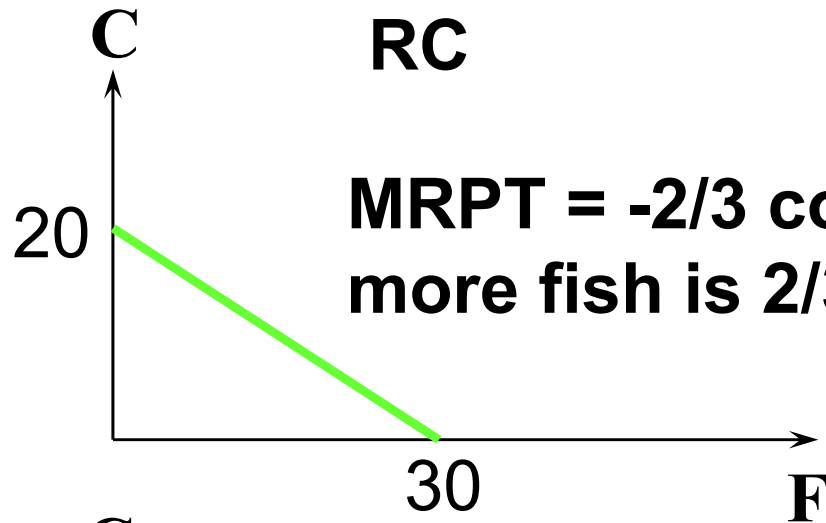


MRPT = $-\frac{2}{3}$ coconuts/fish so opp. cost of one more fish is $\frac{2}{3}$ foregone coconuts.

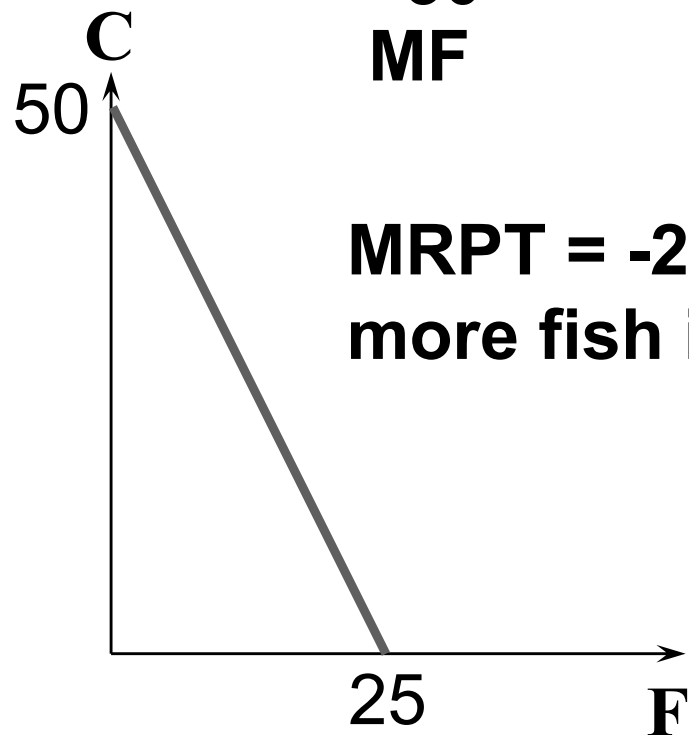


Comparative Advantage

RC



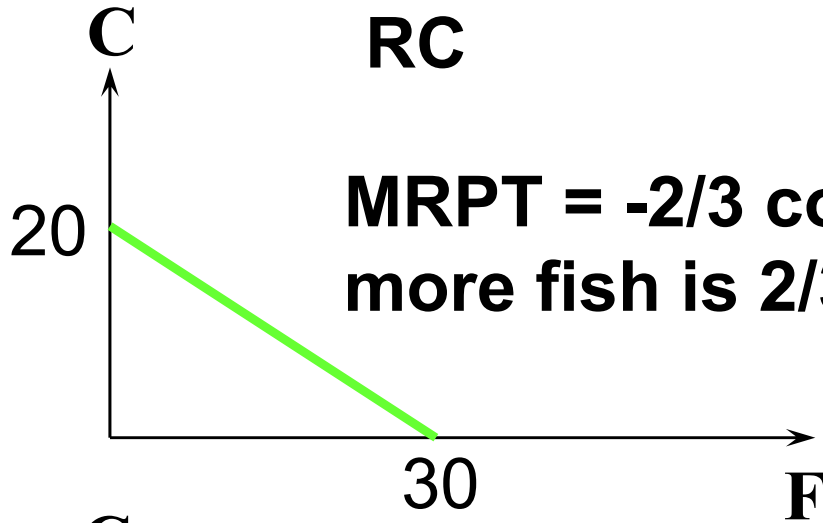
MRPT = $-\frac{2}{3}$ coconuts/fish so opp. cost of one more fish is $\frac{2}{3}$ foregone coconuts.



MRPT = -2 coconuts/fish so opp. cost of one more fish is 2 foregone coconuts.

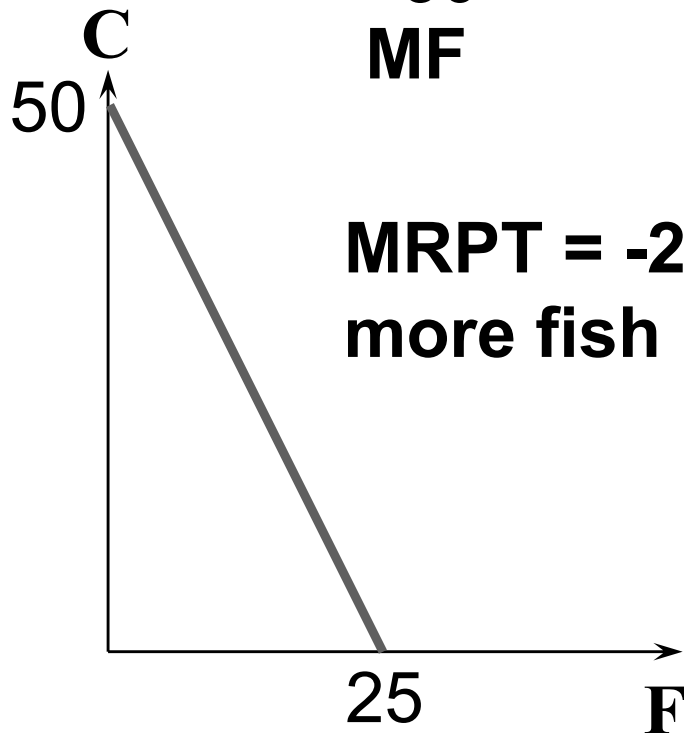
Comparative Advantage

RC



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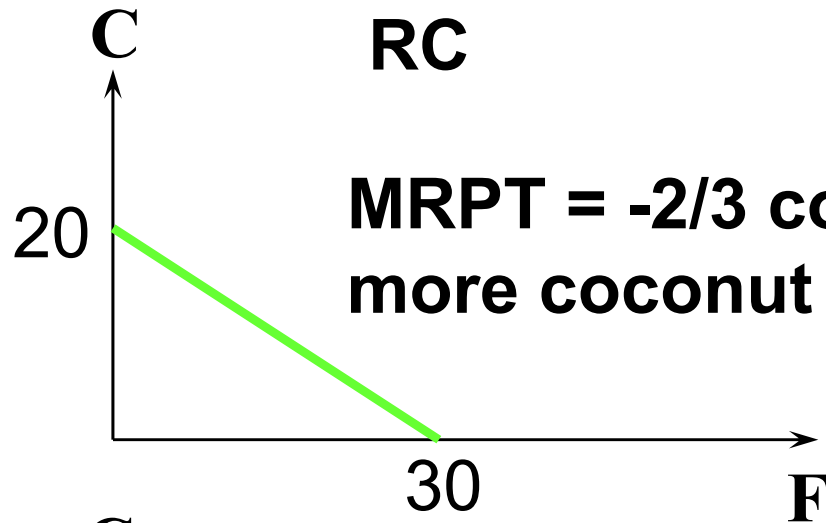
RC has the comparative opp. cost advantage in producing fish.



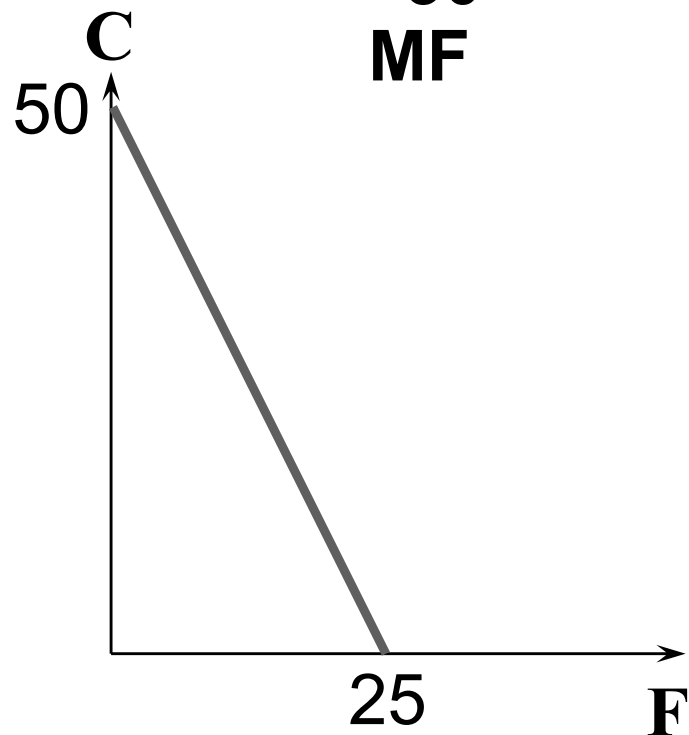
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Comparative Advantage

RC

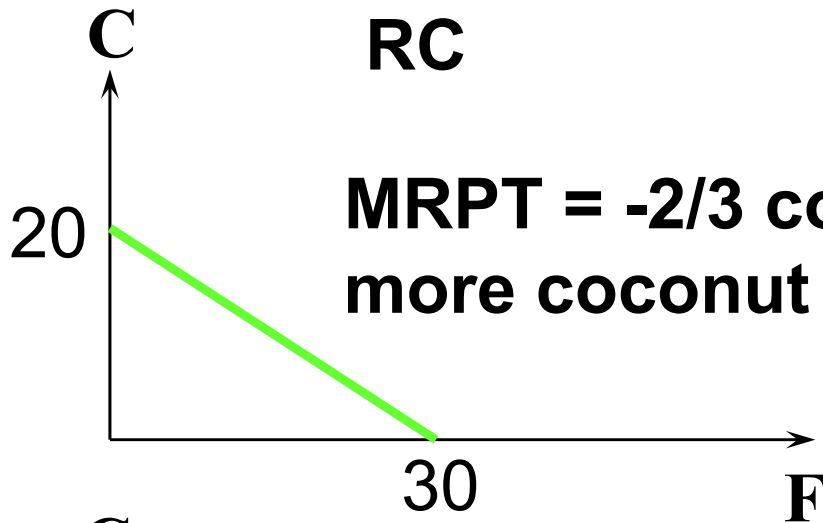


MRPT = $-\frac{2}{3}$ coconuts/fish so opp. cost of one more coconut is $\frac{3}{2}$ foregone fish.



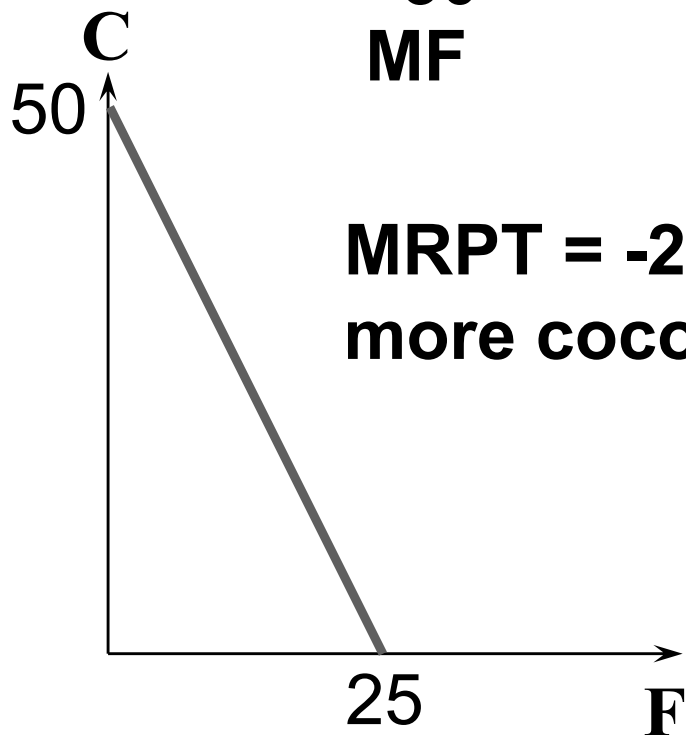
Comparative Advantage

RC



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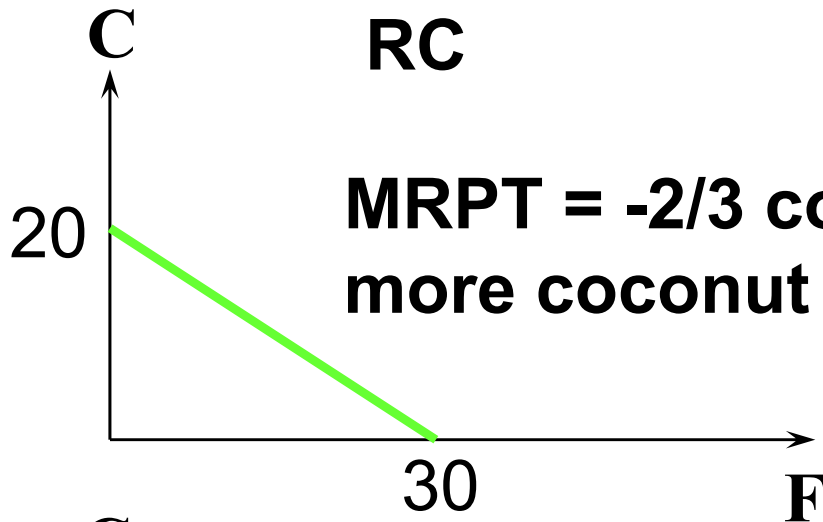
MF



MRPT = -2 coconuts/fish so opp. cost of one more coconut is $\frac{1}{2}$ foregone fish.

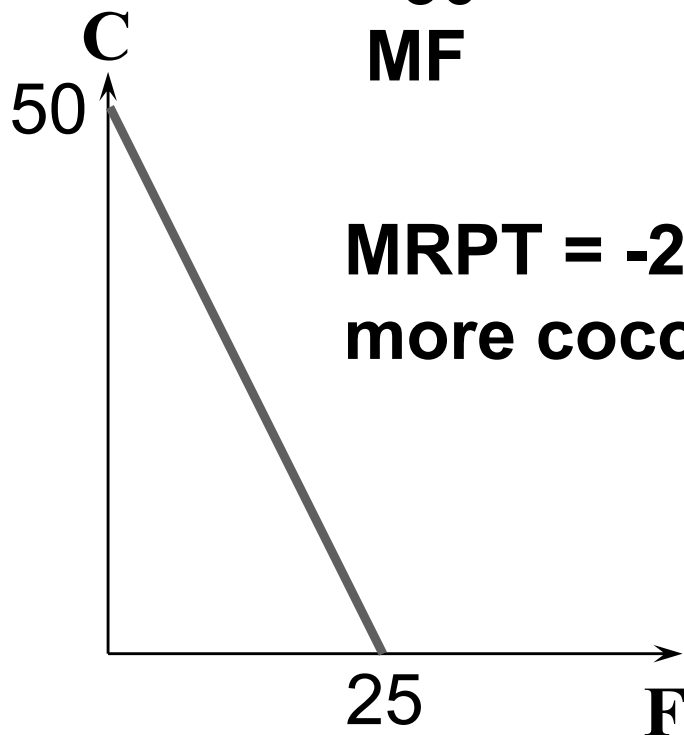
Comparative Advantage

RC



MRPT = $-\frac{2}{3}$ coconuts/fish so opp. cost of one more coconut is $\frac{3}{2}$ foregone fish.

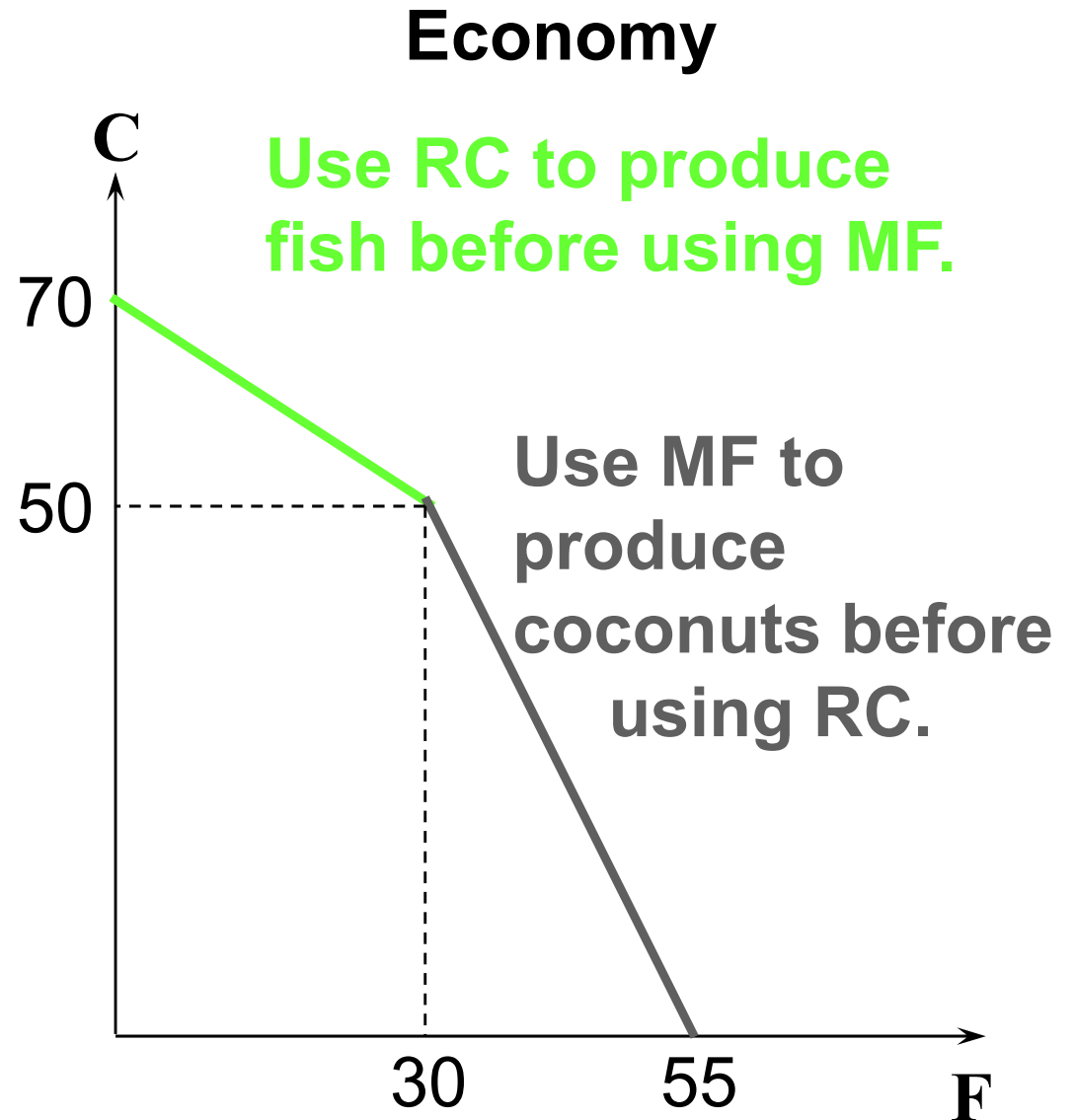
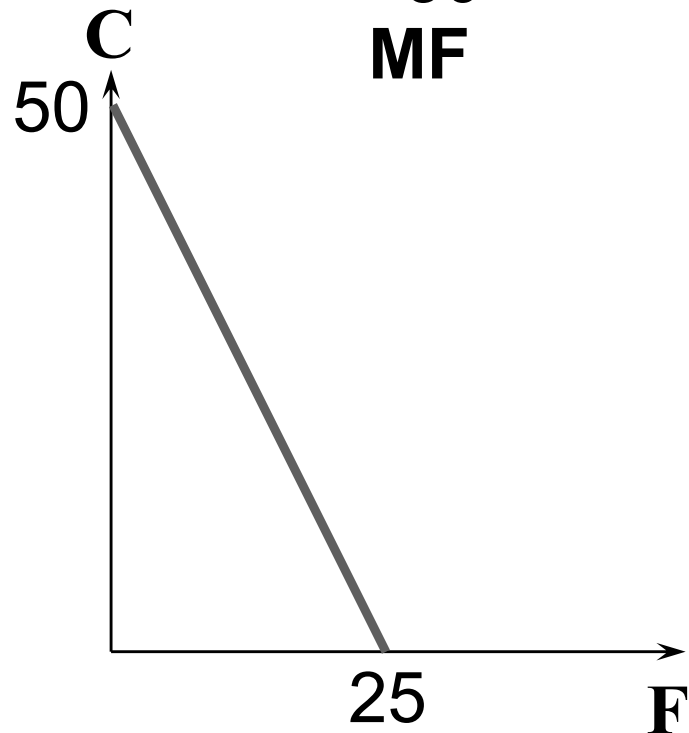
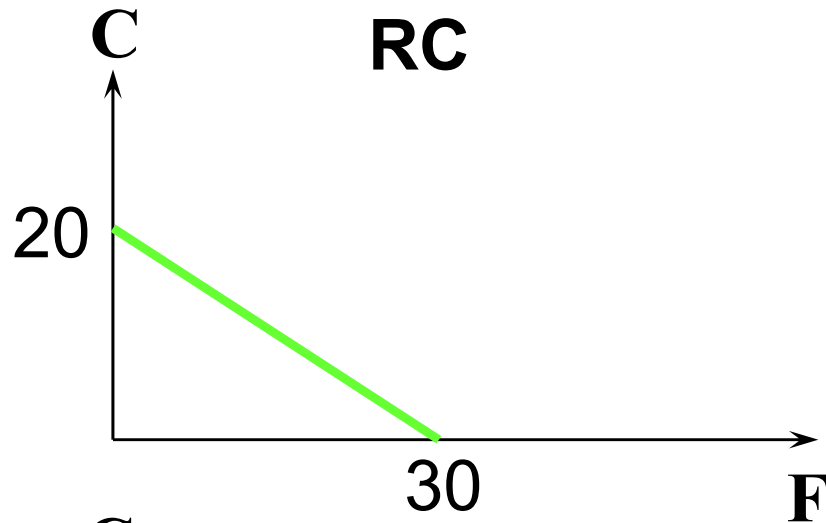
MF



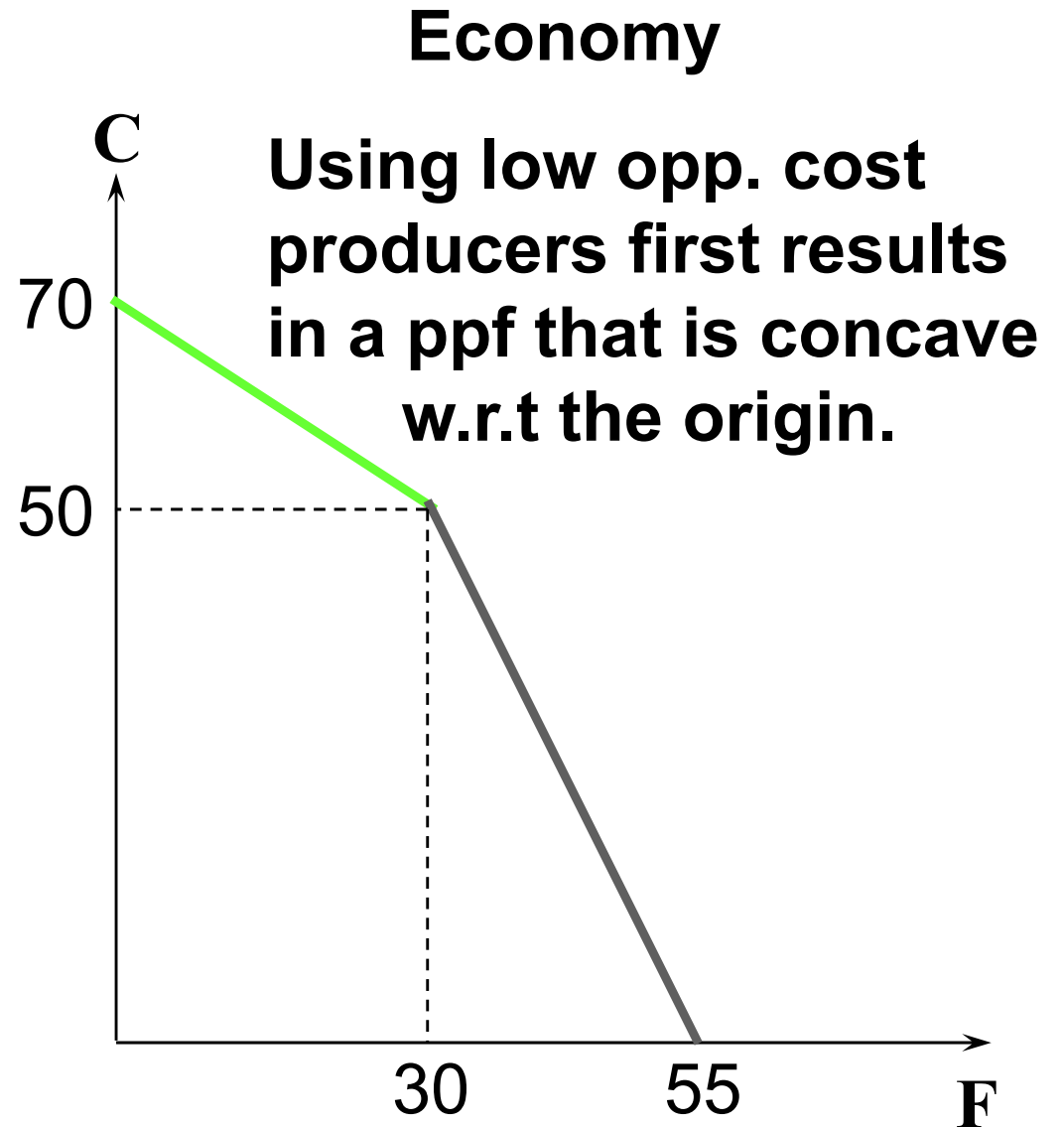
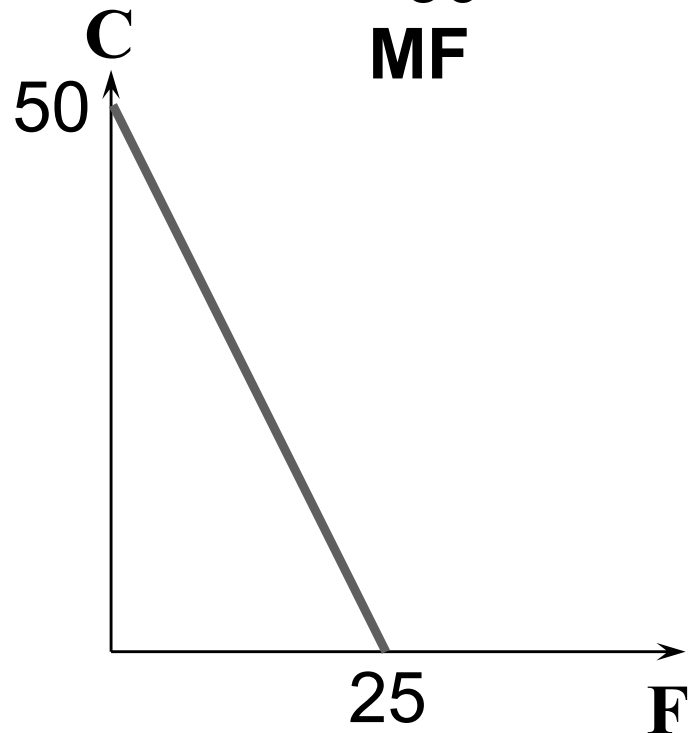
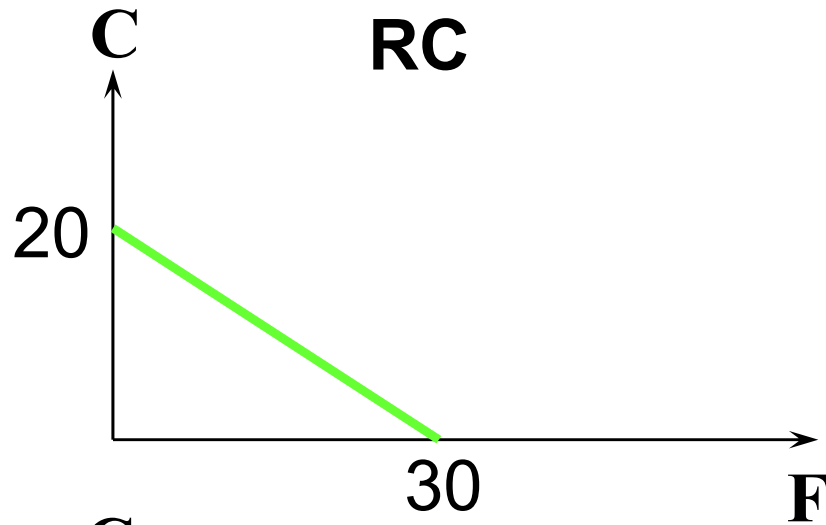
MRPT = -2 coconuts/fish so opp. cost of one more coconut is $\frac{1}{2}$ foregone fish.

MF has the comparative opp. cost advantage in producing coconuts.

Comparative Advantage



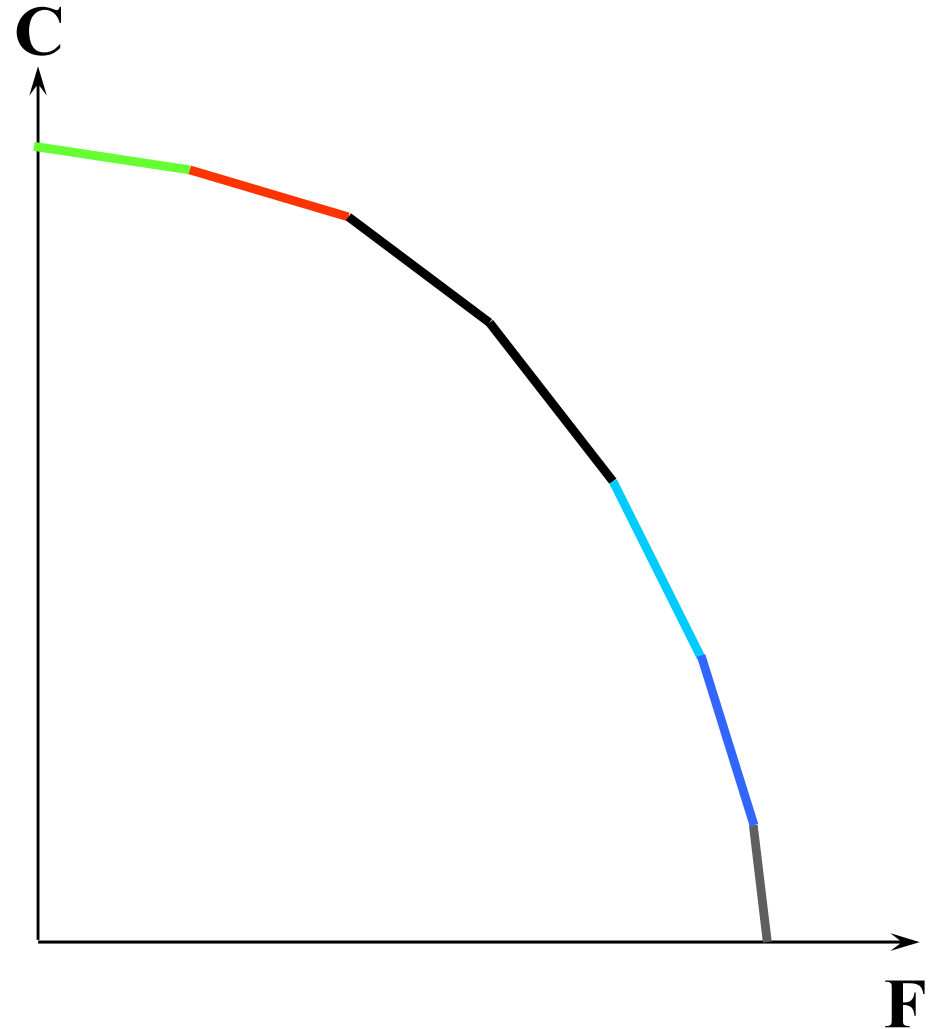
Comparative Advantage



Comparative Advantage

Economy

**More producers with
different opp. costs
“smooth out” the ppf.**



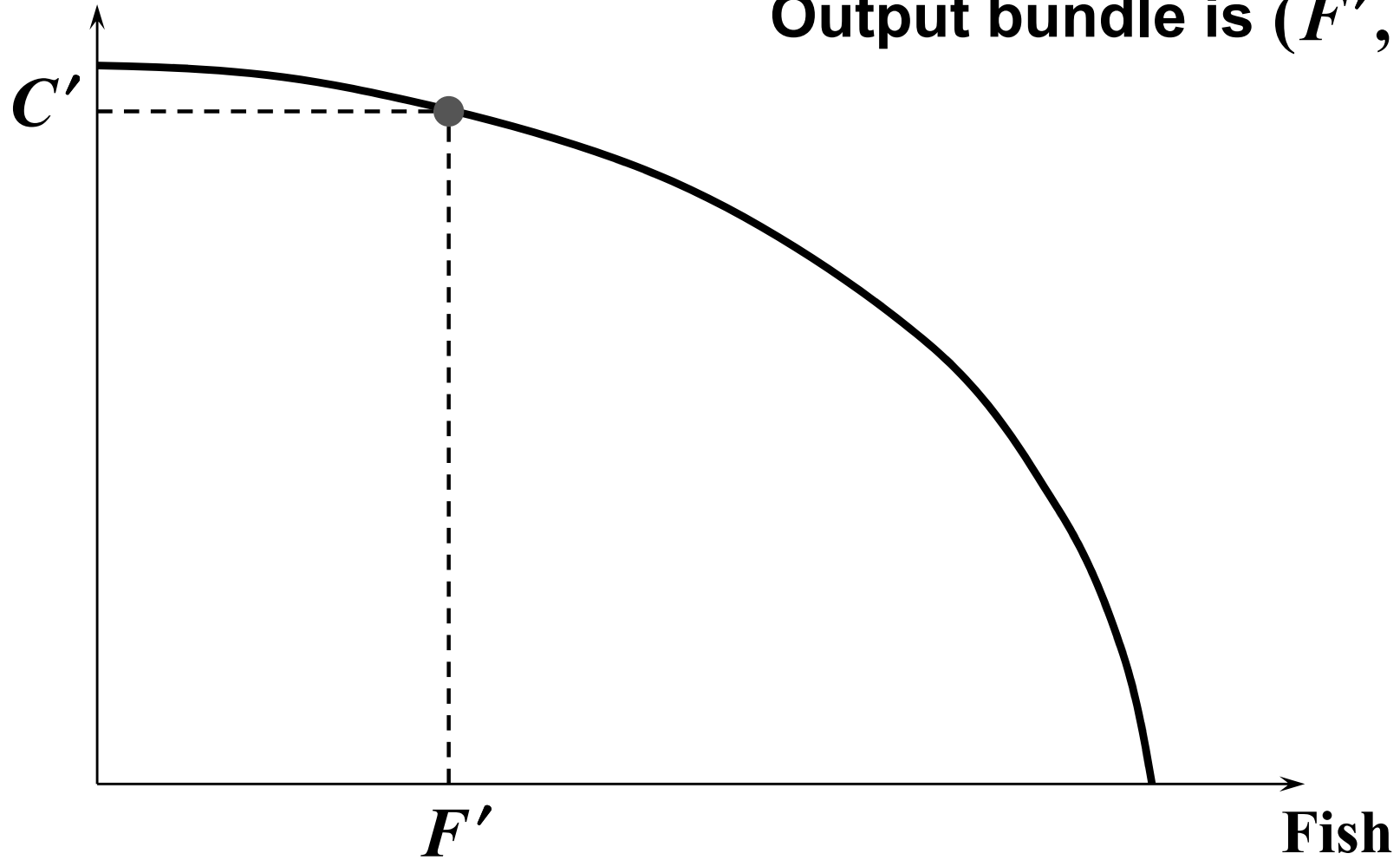
Coordinating Production & Consumption

- ◆ **The ppf contains many technically efficient output bundles.**
- ◆ **Which are Pareto efficient for consumers?**

Coordinating Production & Consumption

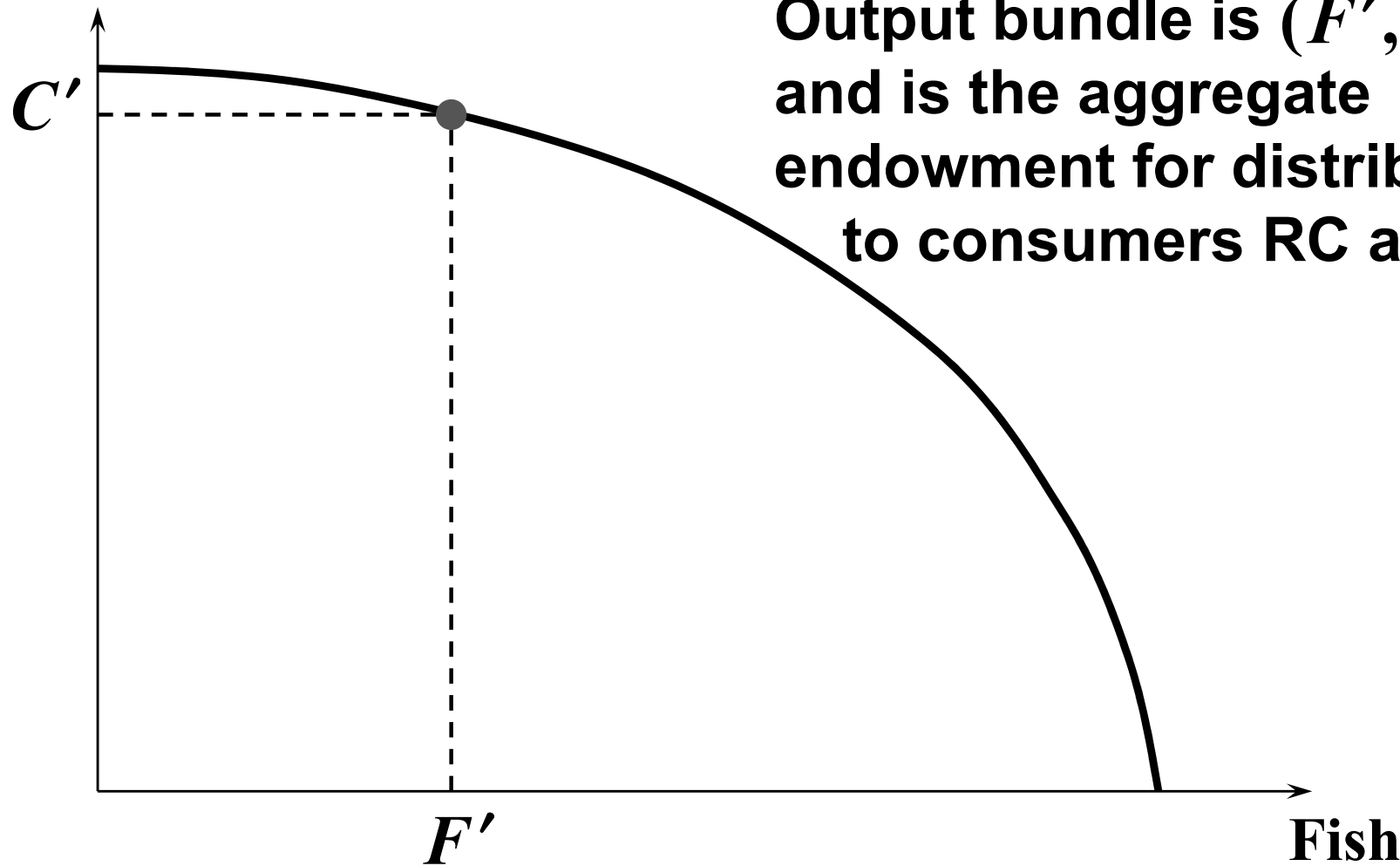
Coconuts

Output bundle is (F', C')



Coordinating Production & Consumption

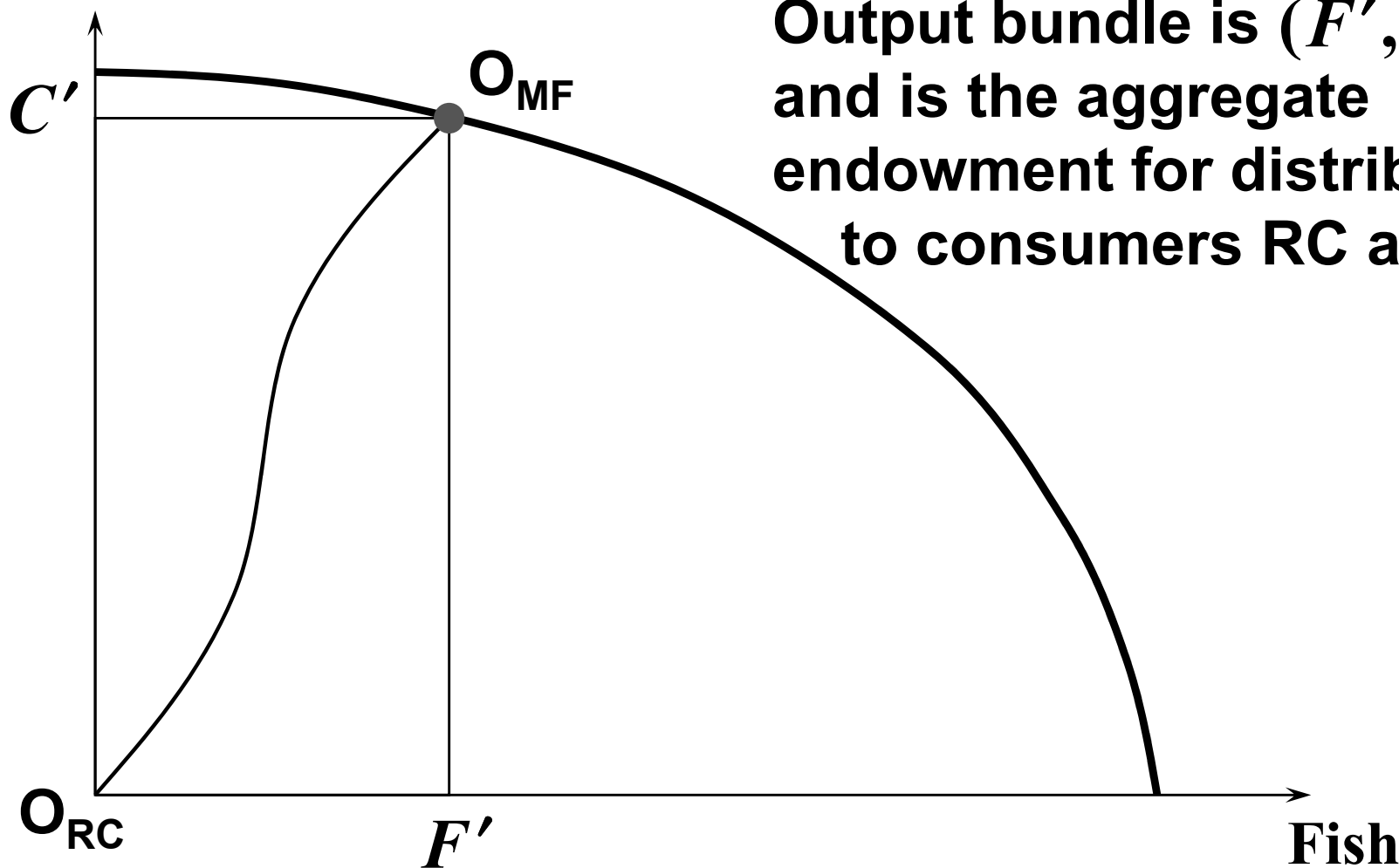
Coconuts



**Output bundle is (F', C')
and is the aggregate
endowment for distribution
to consumers RC and MF.**

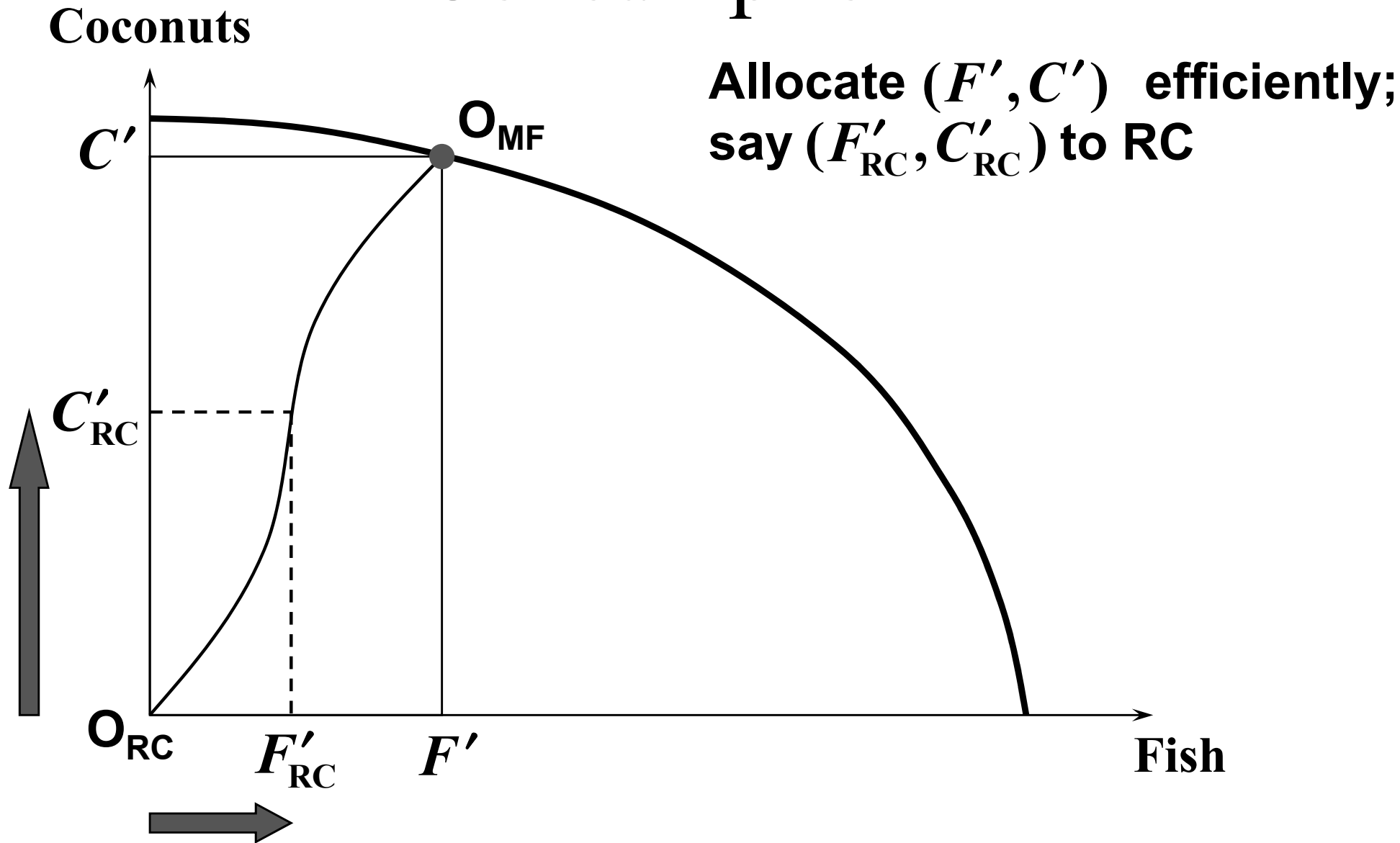
Coordinating Production & Consumption

Coconuts

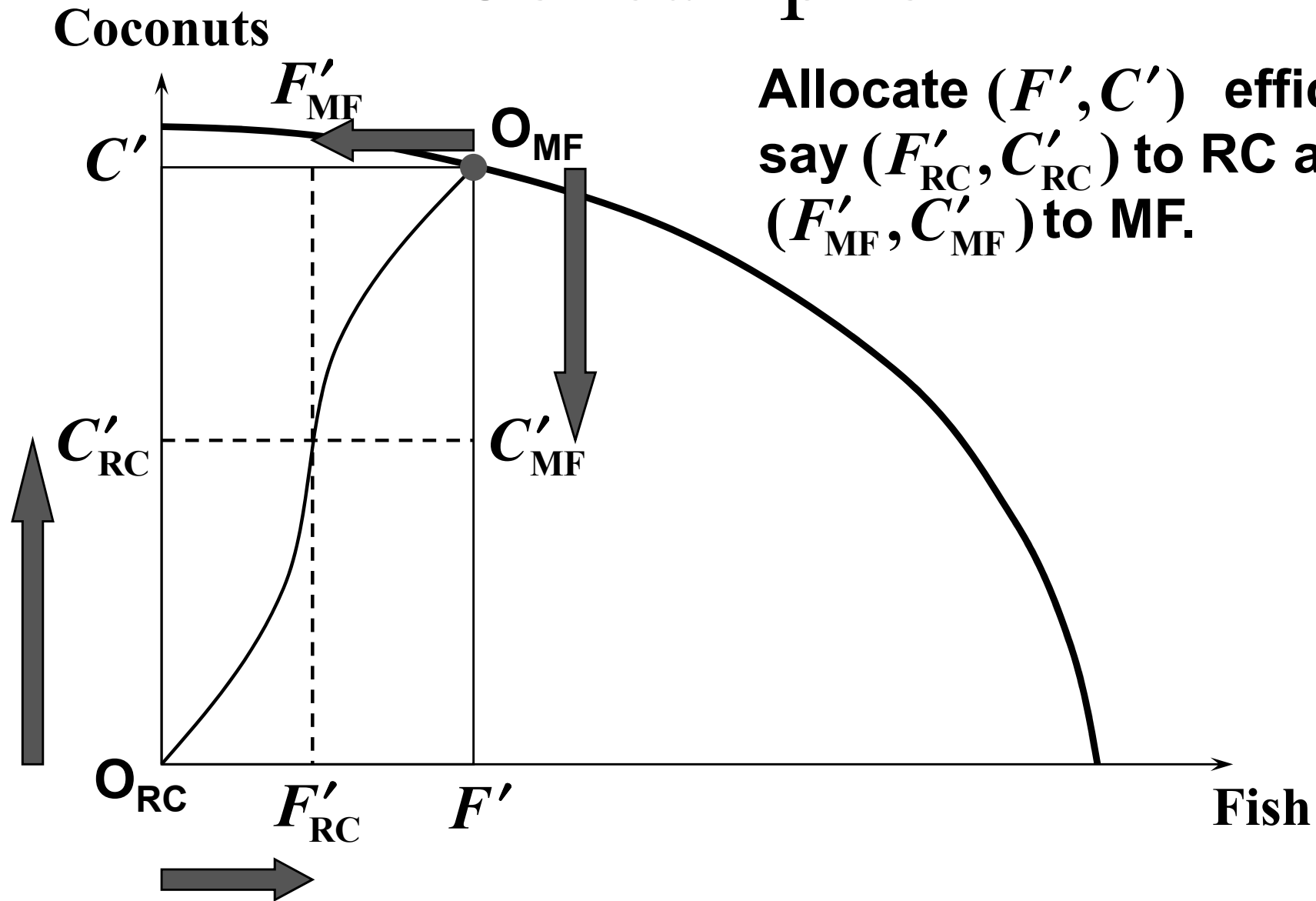


**Output bundle is (F', C')
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Coordinating Production & Consumption



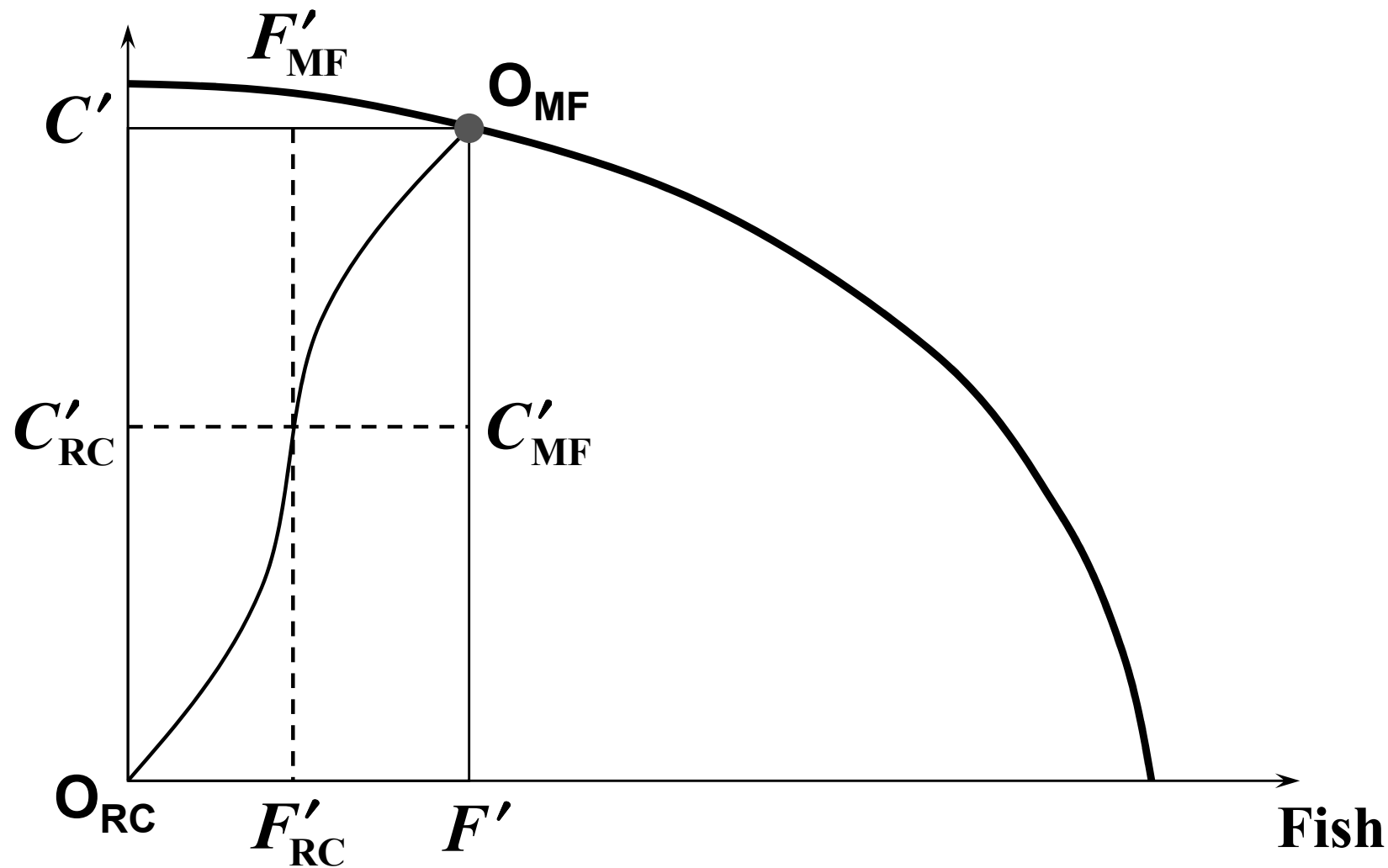
Coordinating Production & Consumption



**Allocate (F', C') efficiently;
say (F'_{RC}, C'_{RC}) to RC and
 (F'_{MF}, C'_{MF}) to MF.**

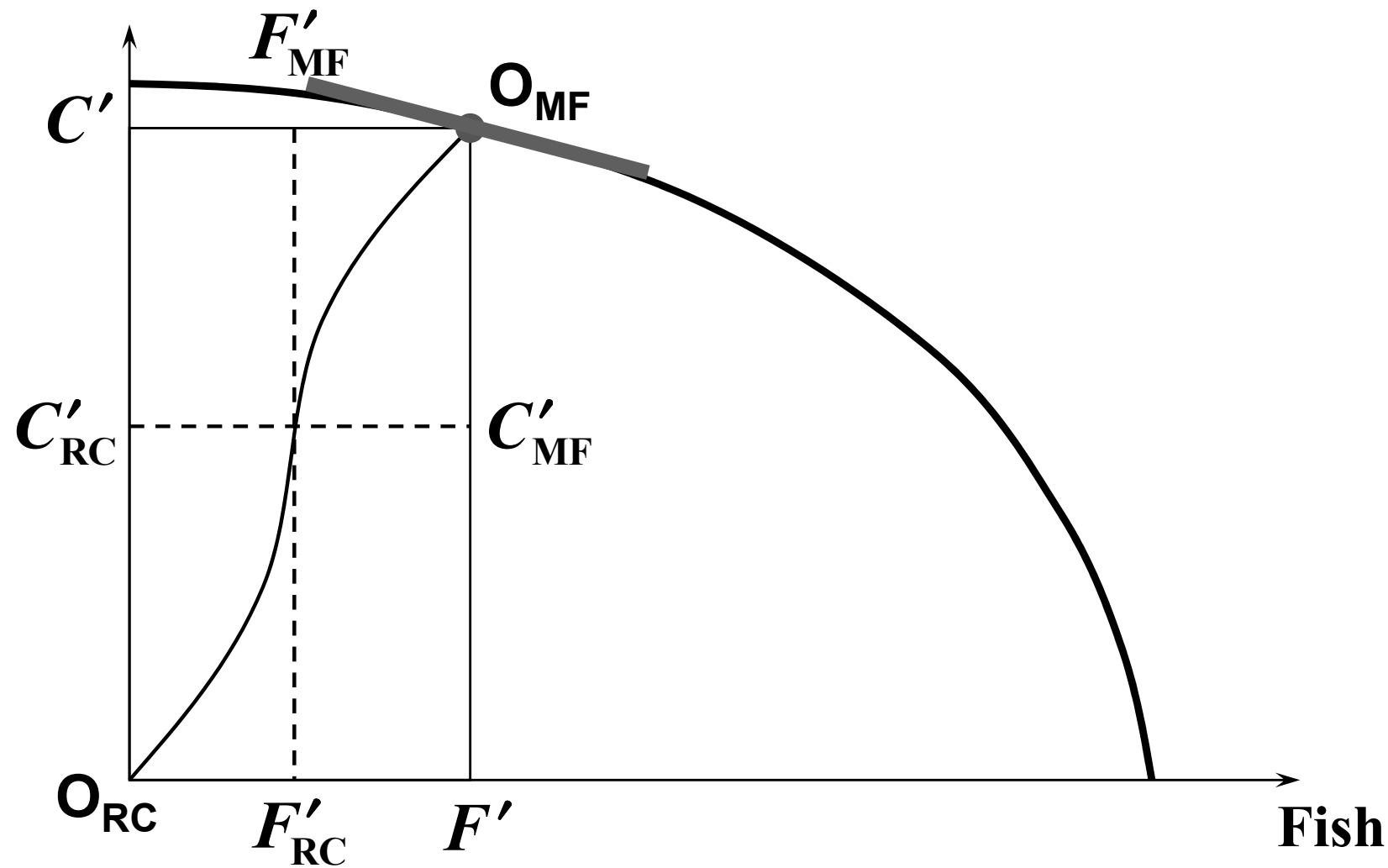
Coordinating Production & Consumption

Coconuts



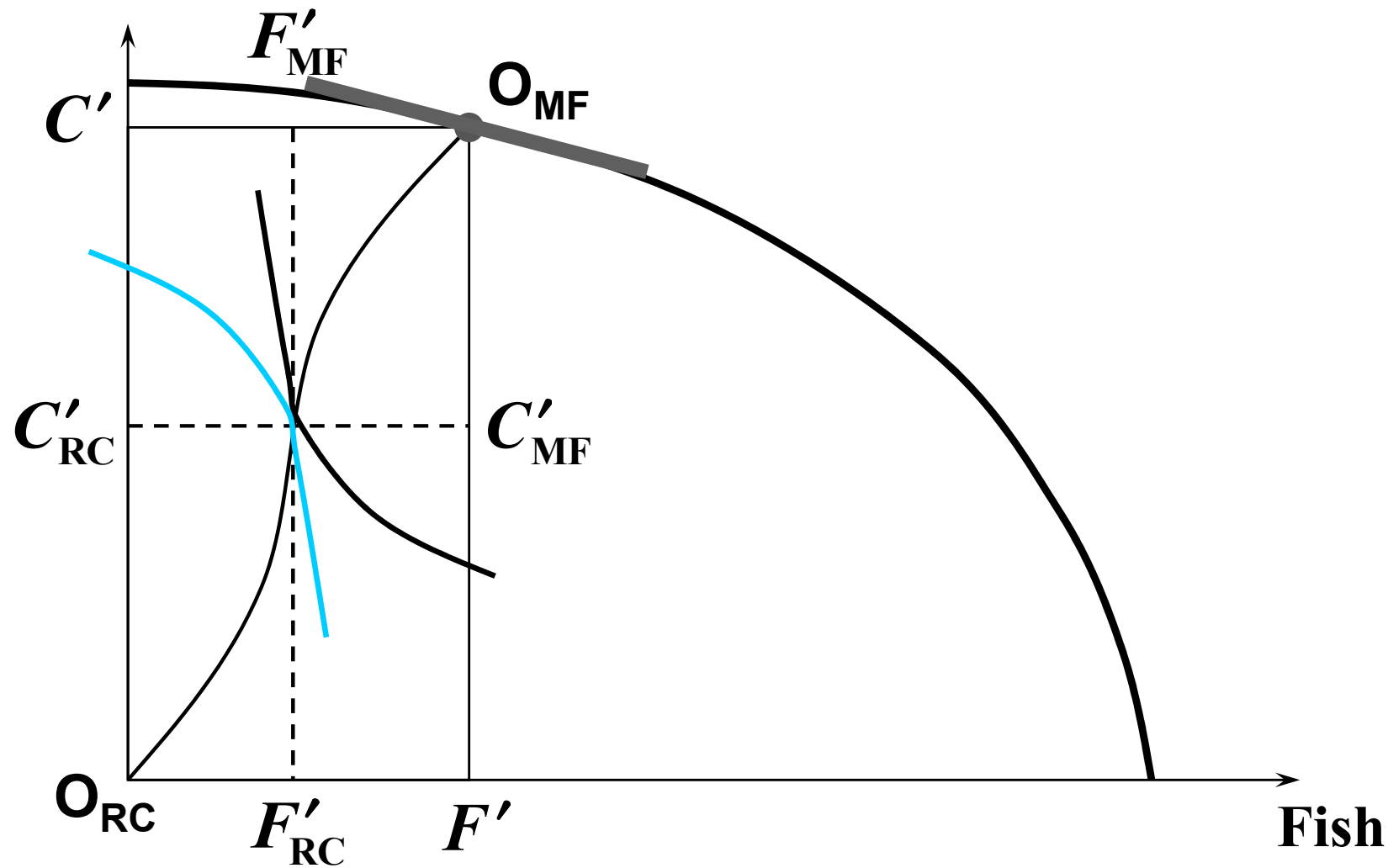
Coordinating Production & Consumption

Coconuts



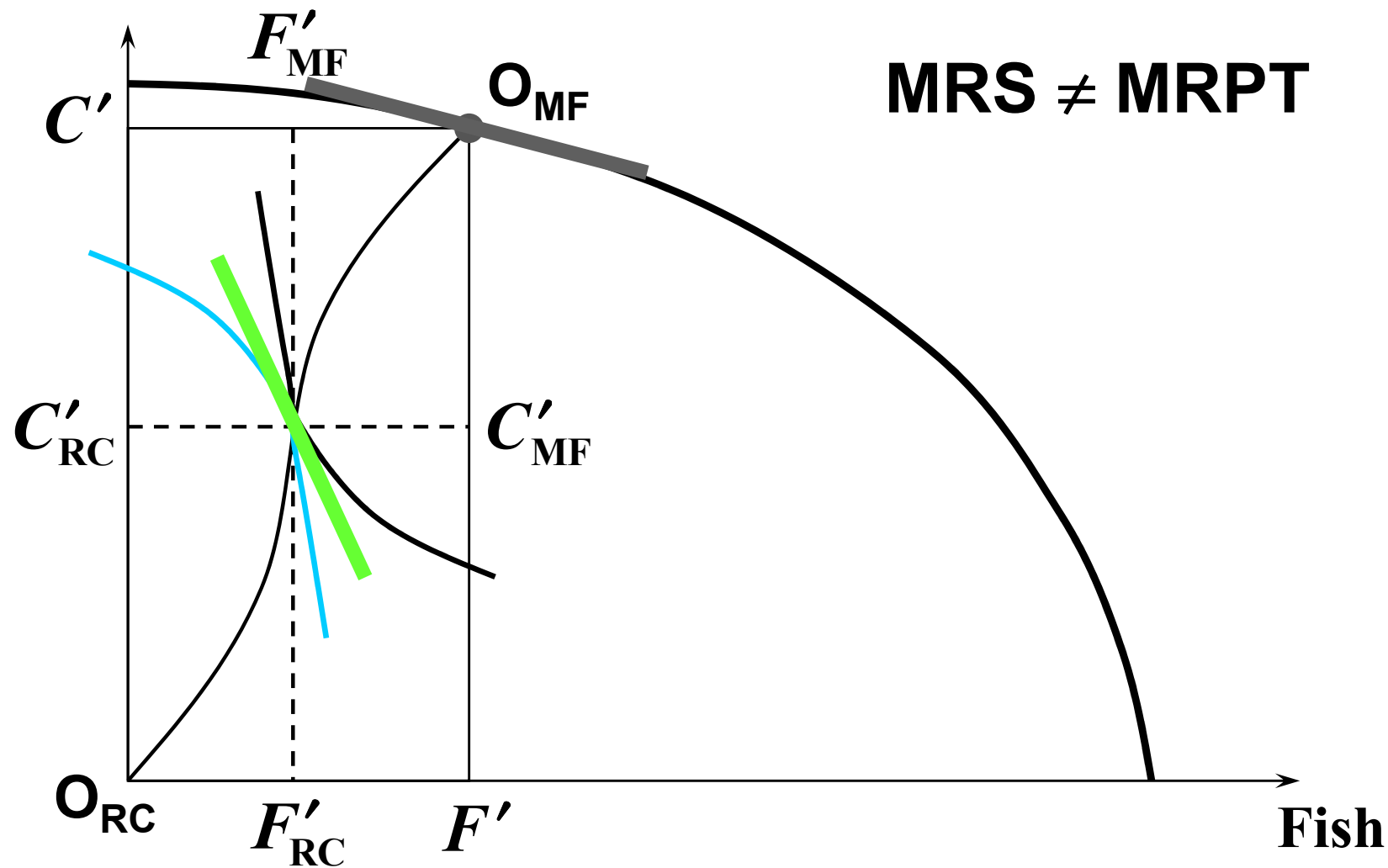
Coordinating Production & Consumption

Coconuts



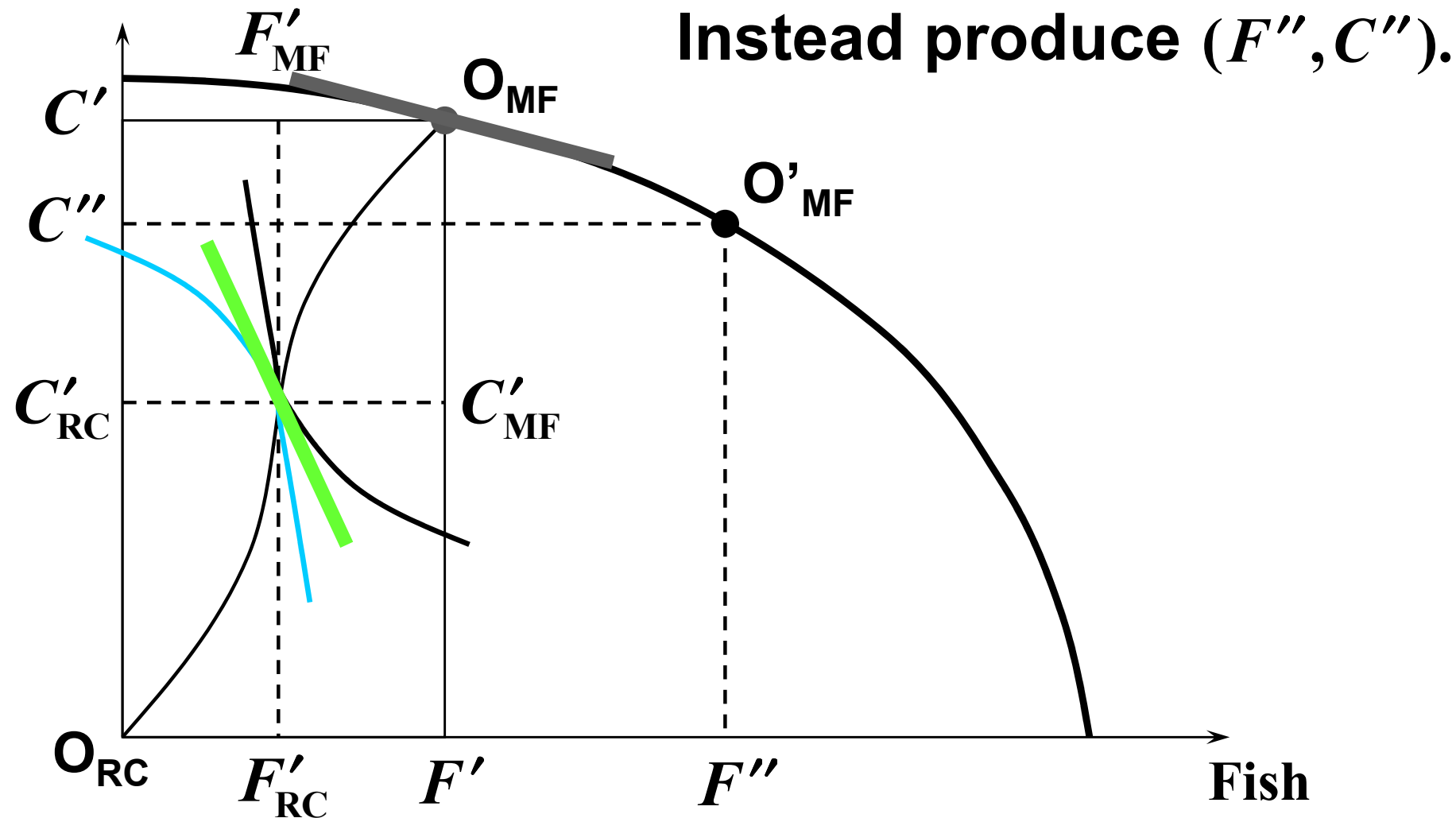
Coordinating Production & Consumption

Coconuts



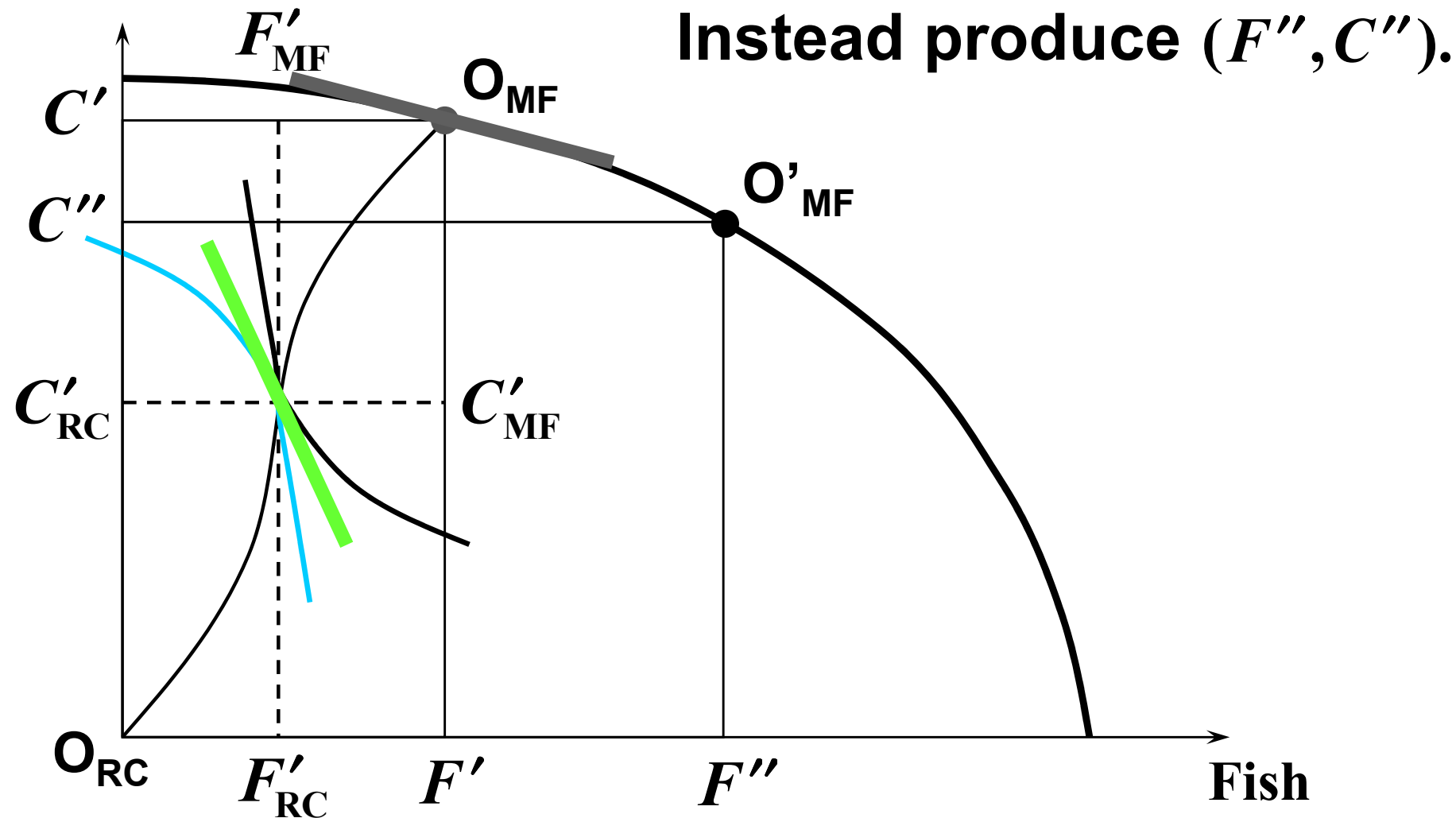
Coordinating Production & Consumption

Coconuts



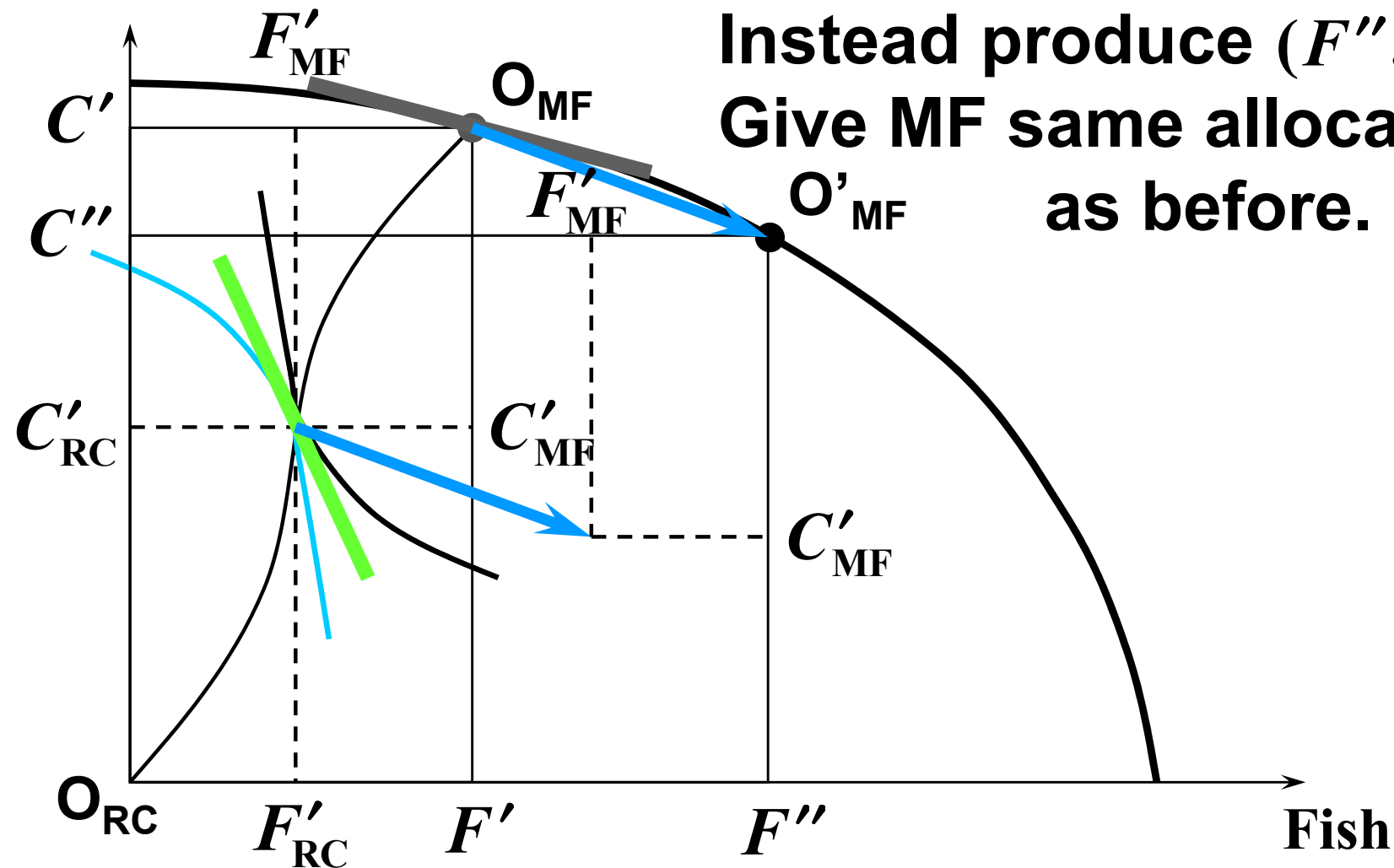
Coordinating Production & Consumption

Coconuts

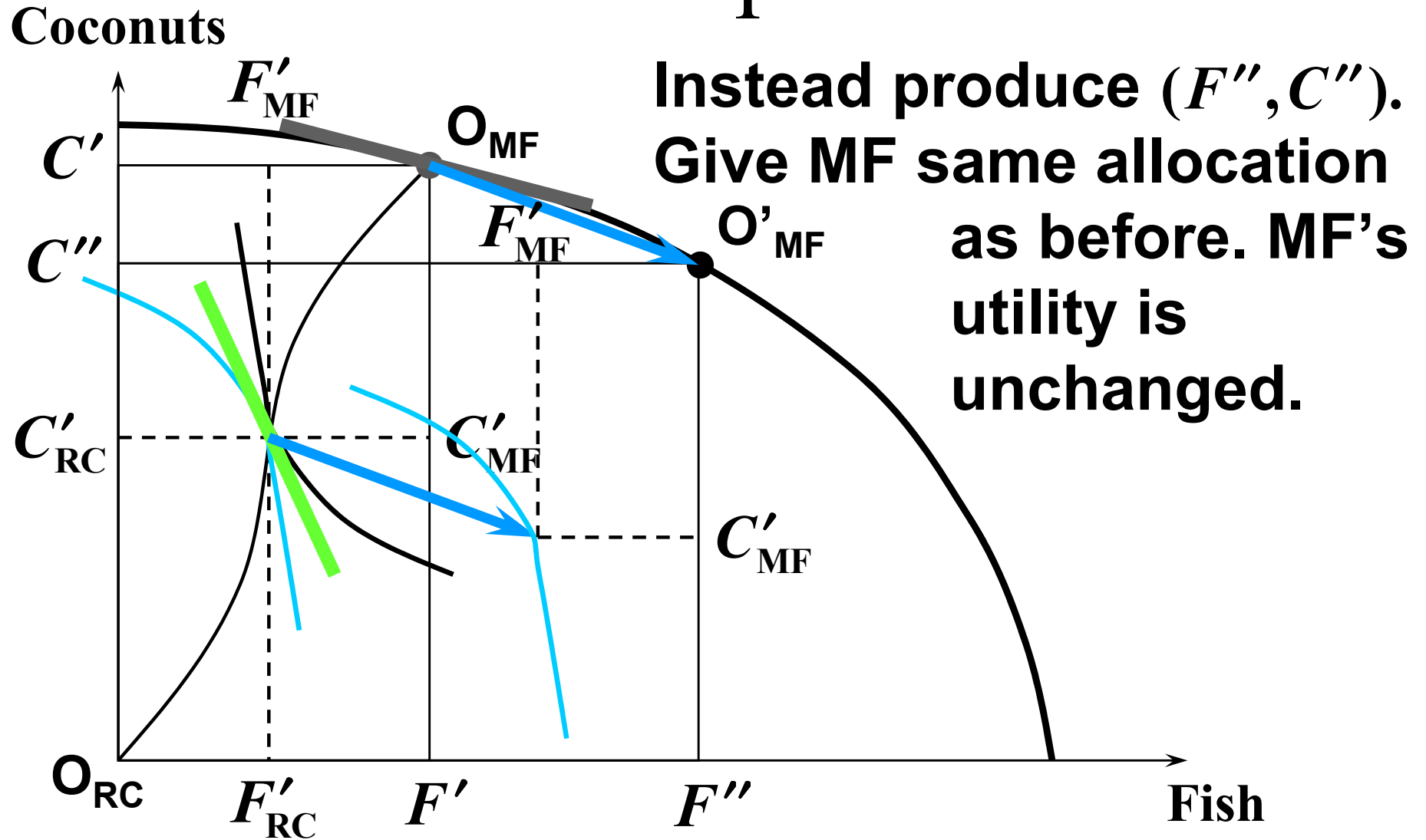


Coordinating Production & Consumption

Coconuts

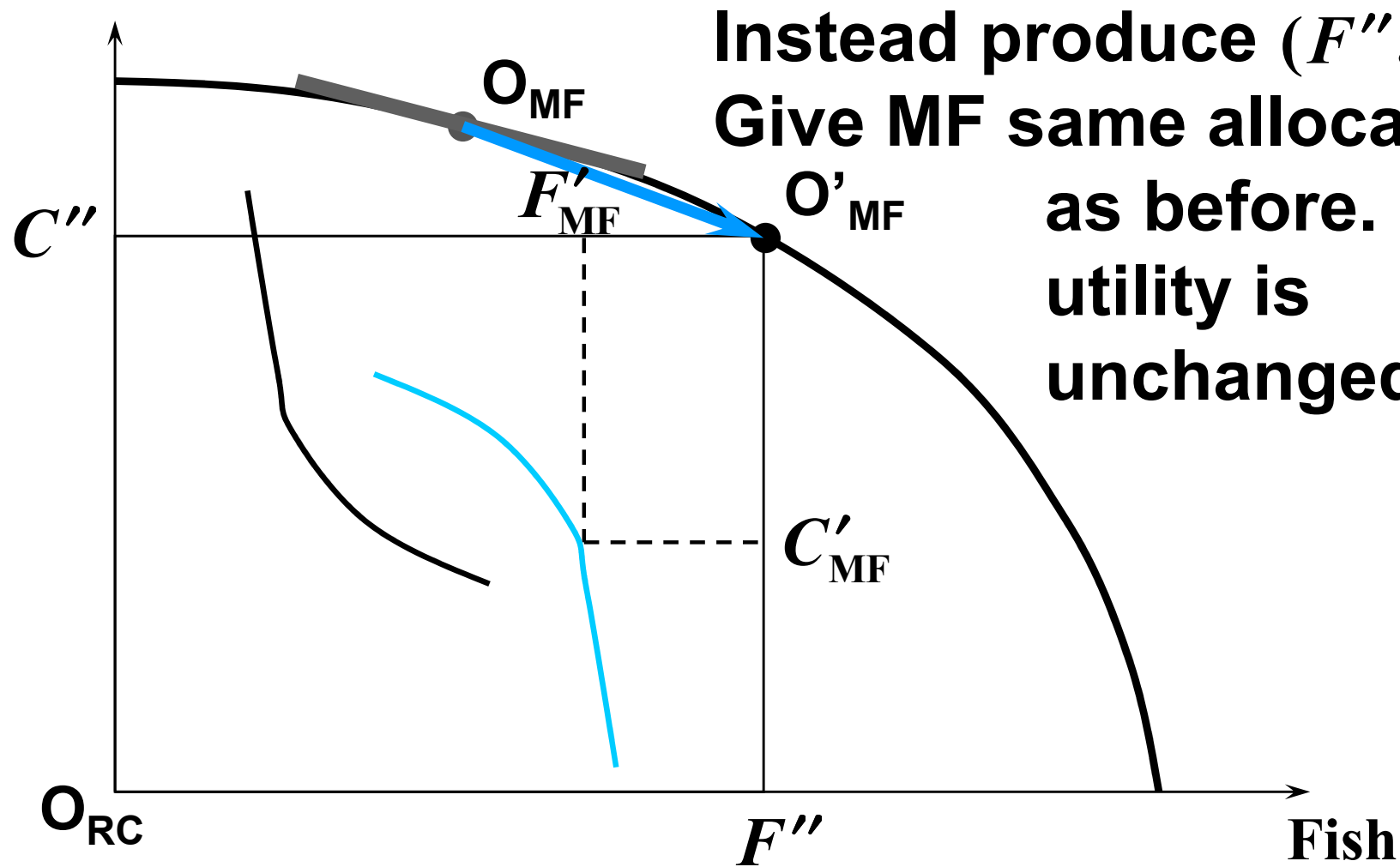


Coordinating Production & Consumption



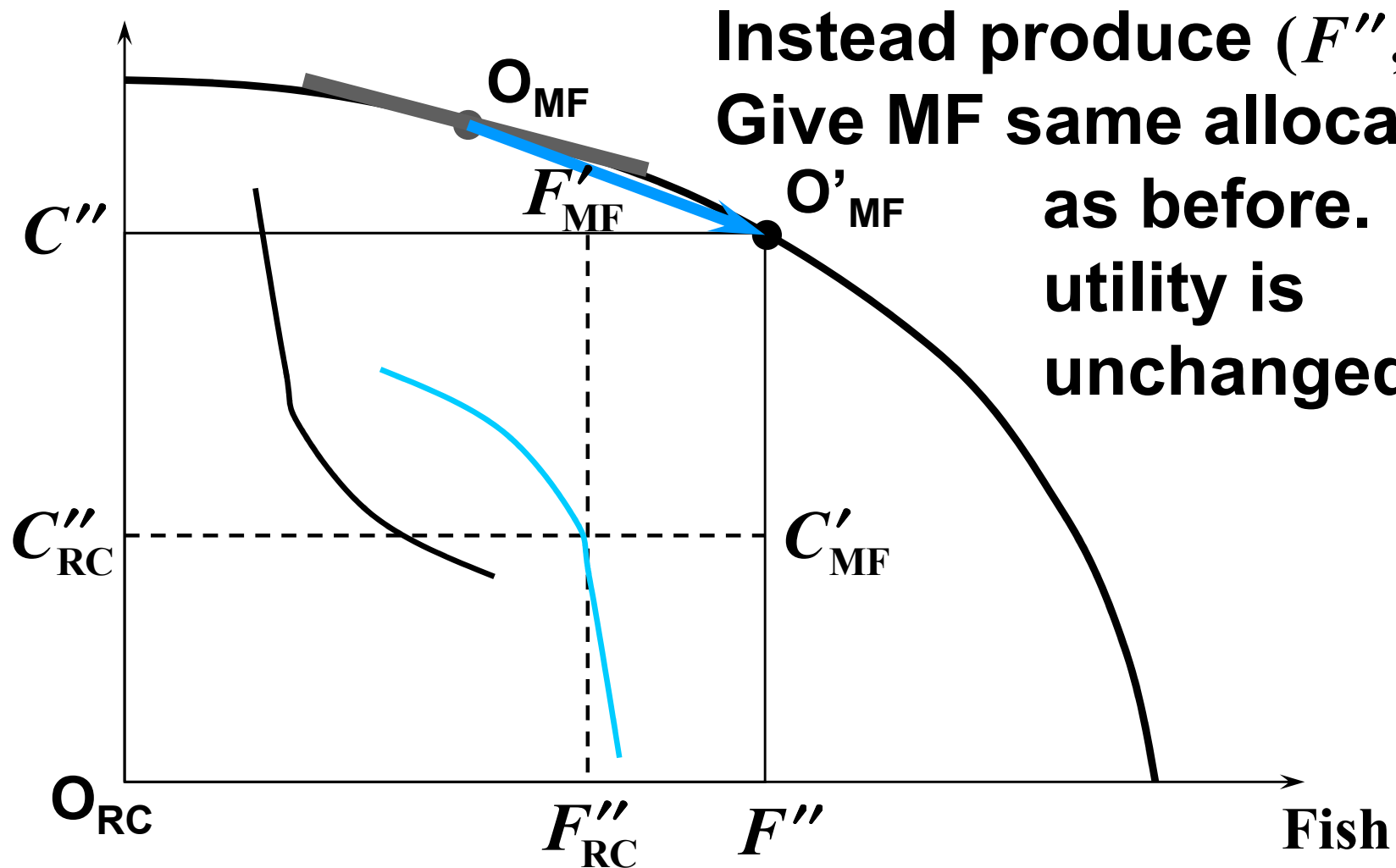
Coordinating Production & Consumption

Coconuts



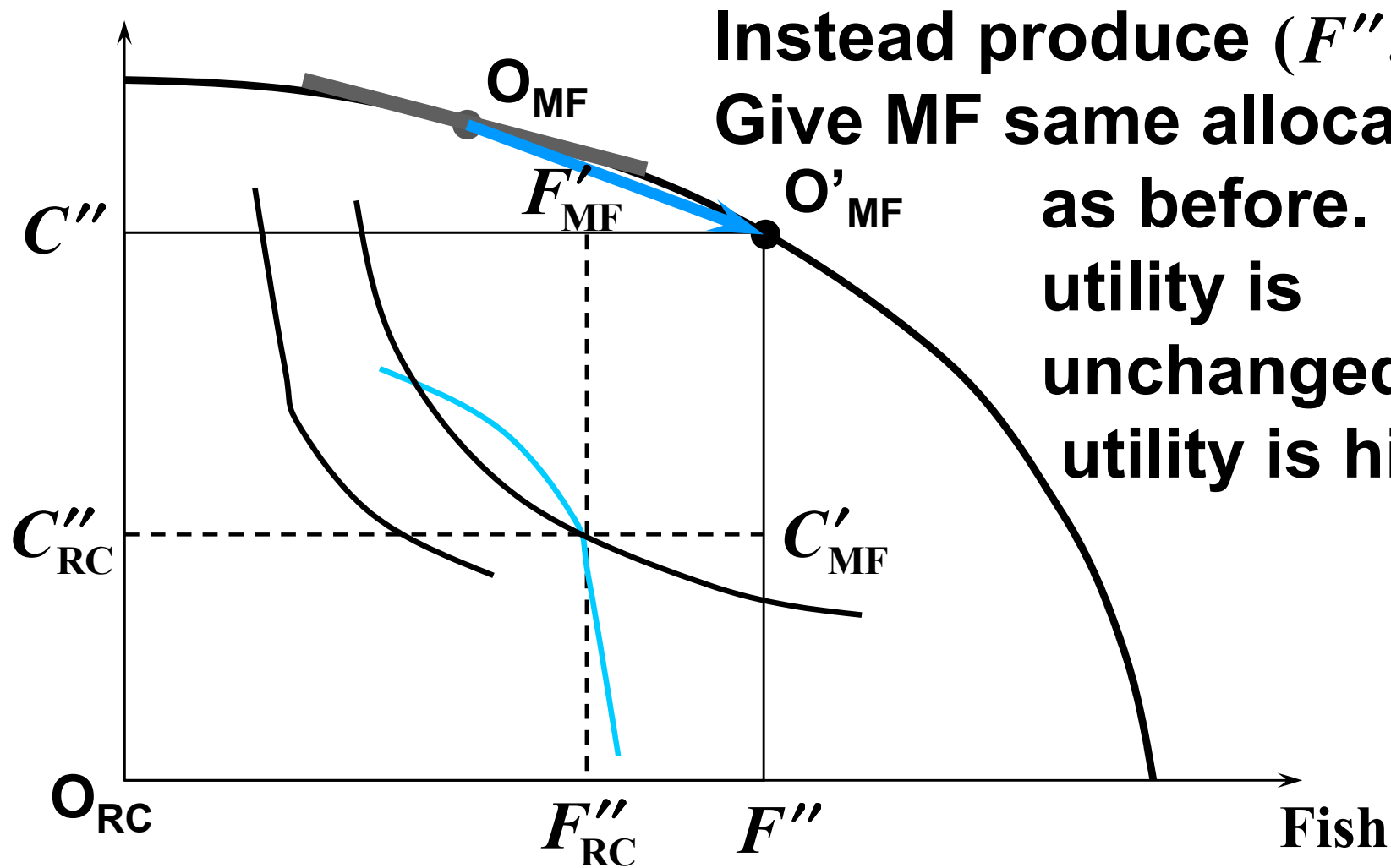
Coordinating Production & Consumption

Coconuts



Coordinating Production & Consumption

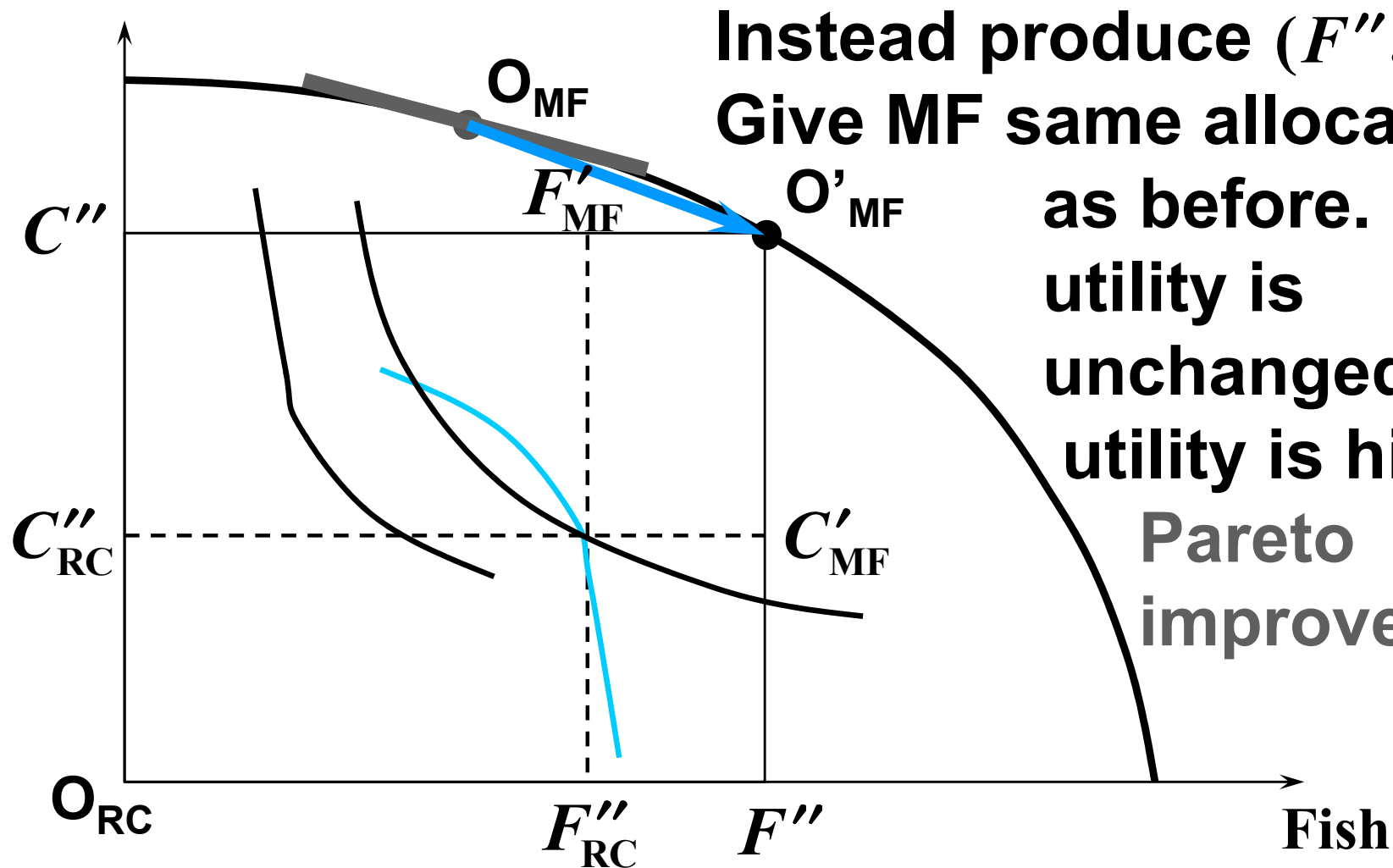
Coconuts



Instead produce (F'', C'') .
Give MF same allocation
as before. MF's
utility is
unchanged, RC's
utility is higher

Coordinating Production & Consumption

Coconuts



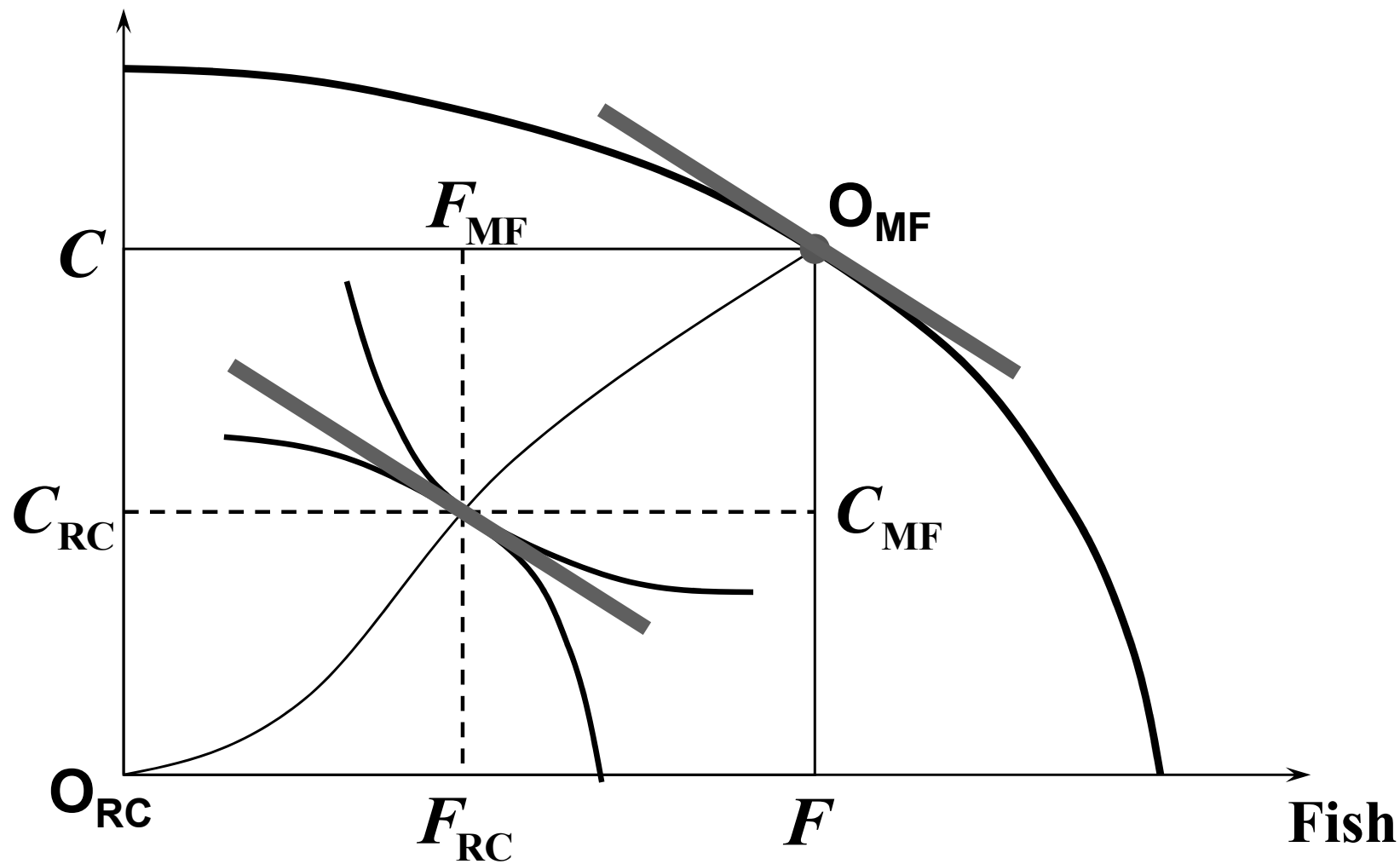
**Instead produce (F'', C'') .
Give MF same allocation
as before. MF's
utility is
unchanged, RC's
utility is higher;
Pareto
improvement.**

Coordinating Production & Consumption

- ◆ **MRS \neq MRPT \Rightarrow inefficient coordination of production and consumption.**
- ◆ **Hence, MRS = MRPT is necessary for a Pareto optimal economic state.**

Coordinating Production & Consumption

Coconuts



Decentralized Coordination of Production & Consumption

- ◆ RC and MF jointly run a firm producing coconuts and fish.
- ◆ RC and MF are also consumers who can sell labor.
- ◆ Price of coconut = p_C .
- ◆ Price of fish = p_F .
- ◆ RC's wage rate = w_{RC} .
- ◆ MF's wage rate = w_{MF} .

Decentralized Coordination of Production & Consumption

- ◆ L_{RC} , L_{MF} are amounts of labor purchased from RC and MF.
- ◆ Firm's profit-maximization problem is choose C , F , L_{RC} and L_{MF} to

$$\max \pi = p_C C + p_F F - w_{RC} L_{RC} - w_{MF} L_{MF}.$$

Decentralized Coordination of Production & Consumption

$$\max \pi = p_C C + p_F F - w_{RC} L_{RC} - w_{MF} L_{MF} \cdot$$

Isoprofit line equation is

$$\text{constant } \pi = p_C C + p_F F - w_{RC} L_{RC} - w_{MF} L_{MF}$$

Decentralized Coordination of Production & Consumption

$$\max \pi = p_C C + p_F F - w_{RC} L_{RC} - w_{MF} L_{MF}.$$

Isoprofit line equation is

$$\text{constant } \pi = p_C C + p_F F - w_{RC} L_{RC} - w_{MF} L_{MF}$$

which rearranges to

$$C = \frac{\pi + w_{RC} L_{RC} + w_{MF} L_{MF}}{p_C} - \frac{p_F}{p_C} F.$$

Decentralized Coordination of Production & Consumption

$$\max \pi = p_C C + p_F F - w_{RC} L_{RC} - w_{MF} L_{MF}.$$

Isoprofit line equation is

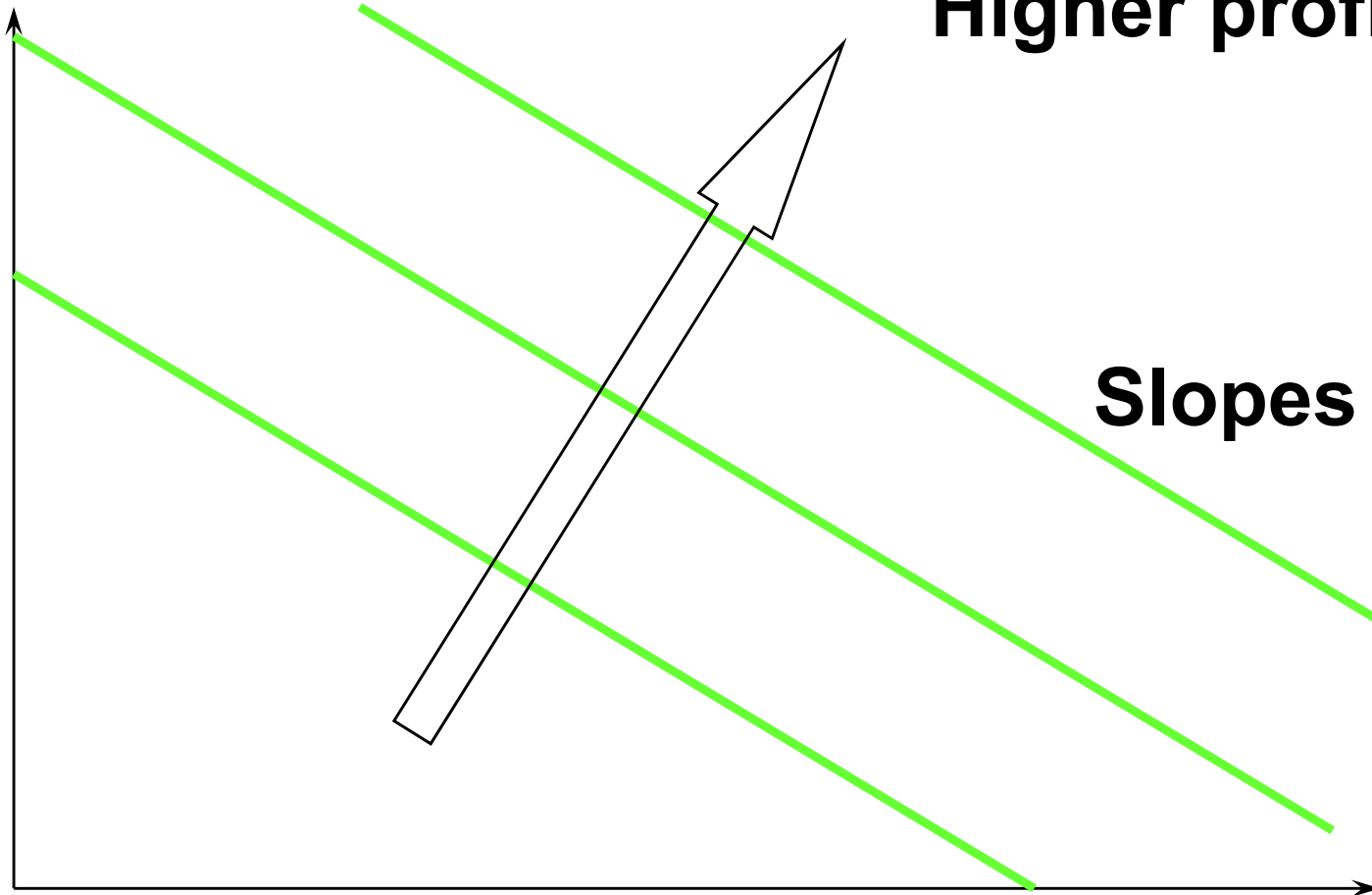
$$\text{constant } \pi = p_C C + p_F F - w_{RC} L_{RC} - w_{MF} L_{MF}$$

which rearranges to

$$C = \underbrace{\frac{\pi + w_{RC} L_{RC} + w_{MF} L_{MF}}{p_C}}_{\text{intercept}} - \underbrace{\frac{p_F}{p_C}}_{\text{slope}} F.$$

Decentralized Coordination of Production & Consumption

Coconuts



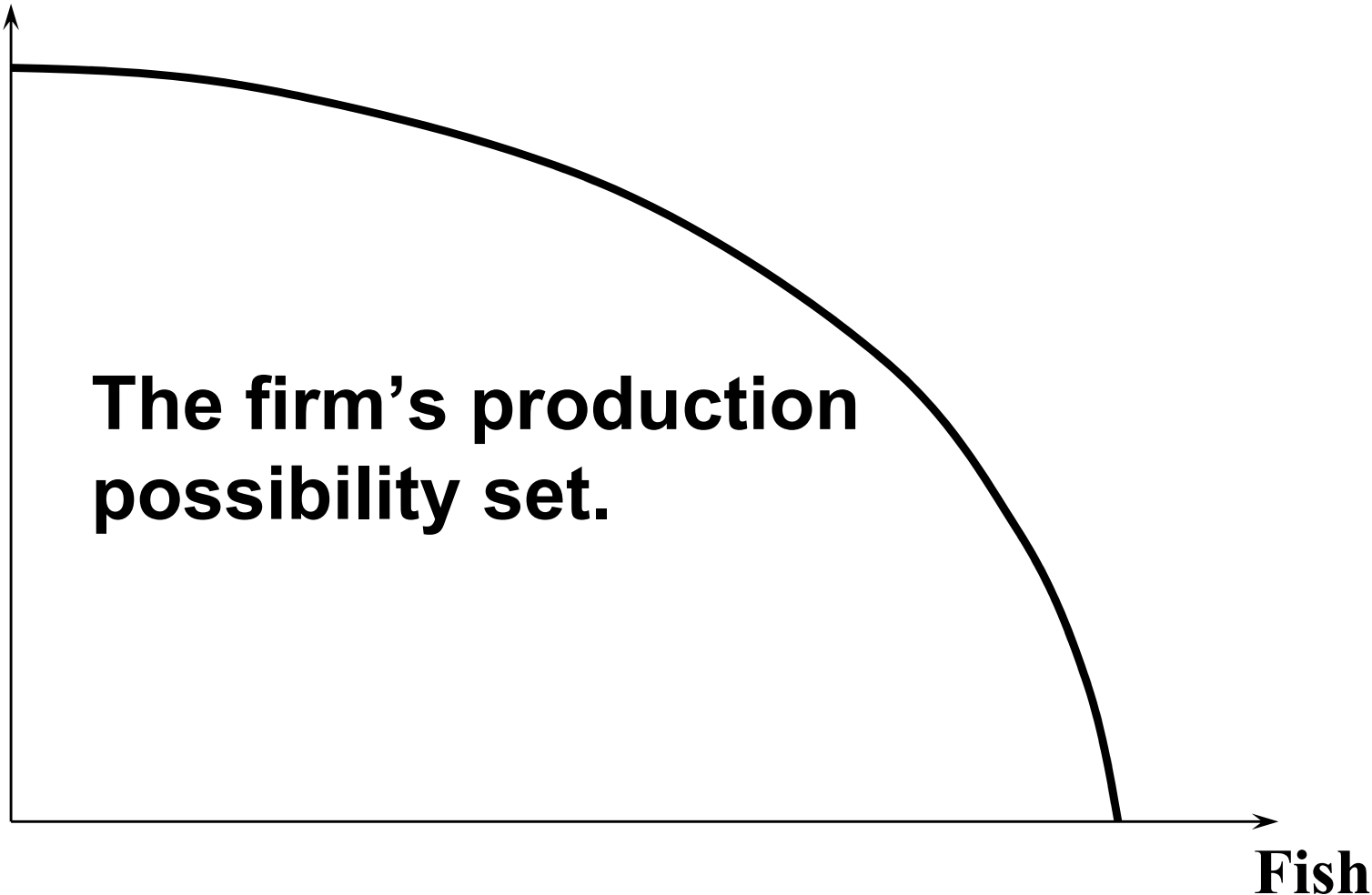
Higher profit

$$\text{Slopes} = -\frac{P_F}{P_C}$$

Fish

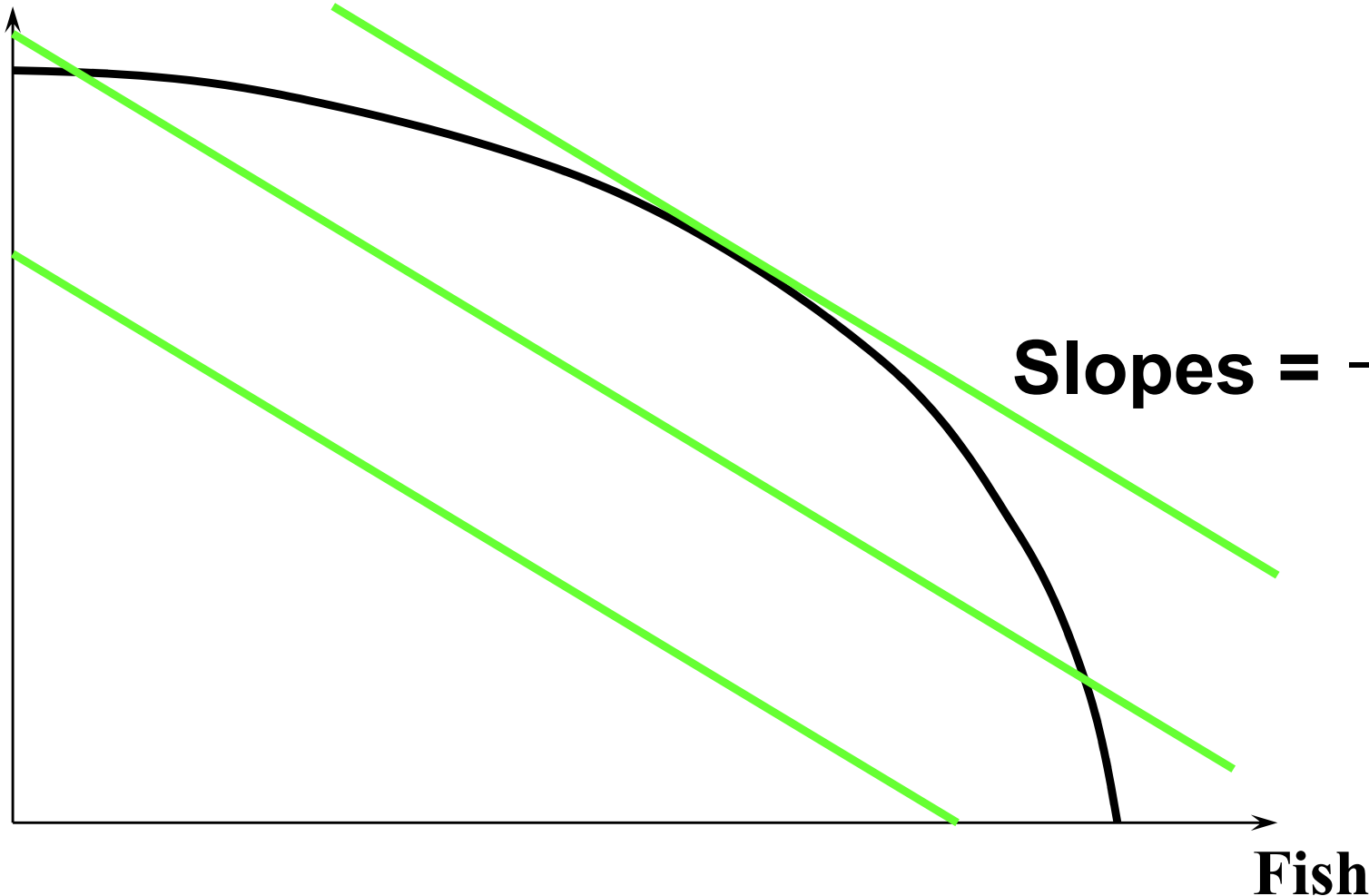
Decentralized Coordination of Production & Consumption

Coconuts



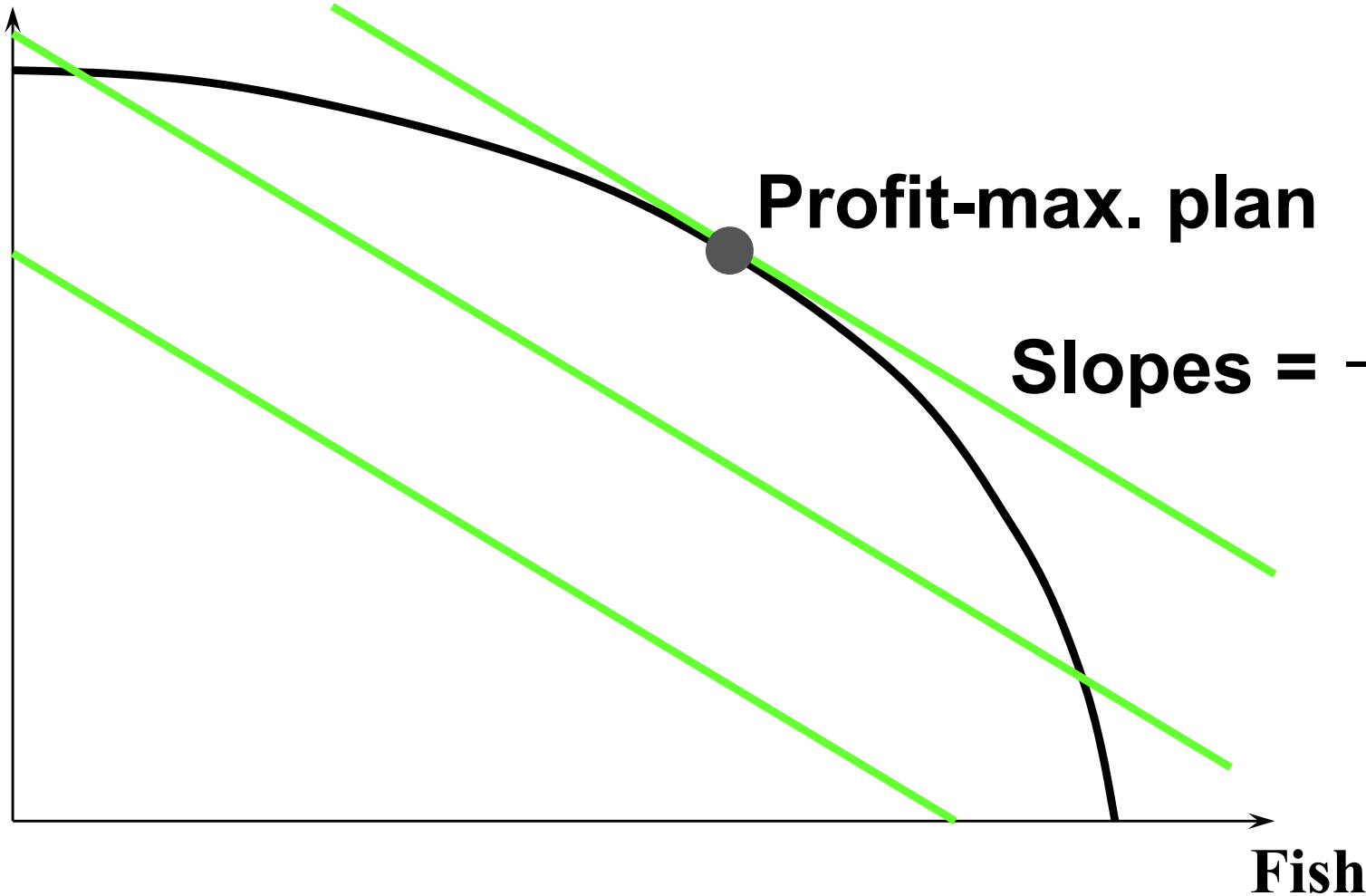
Decentralized Coordination of Production & Consumption

Coconuts

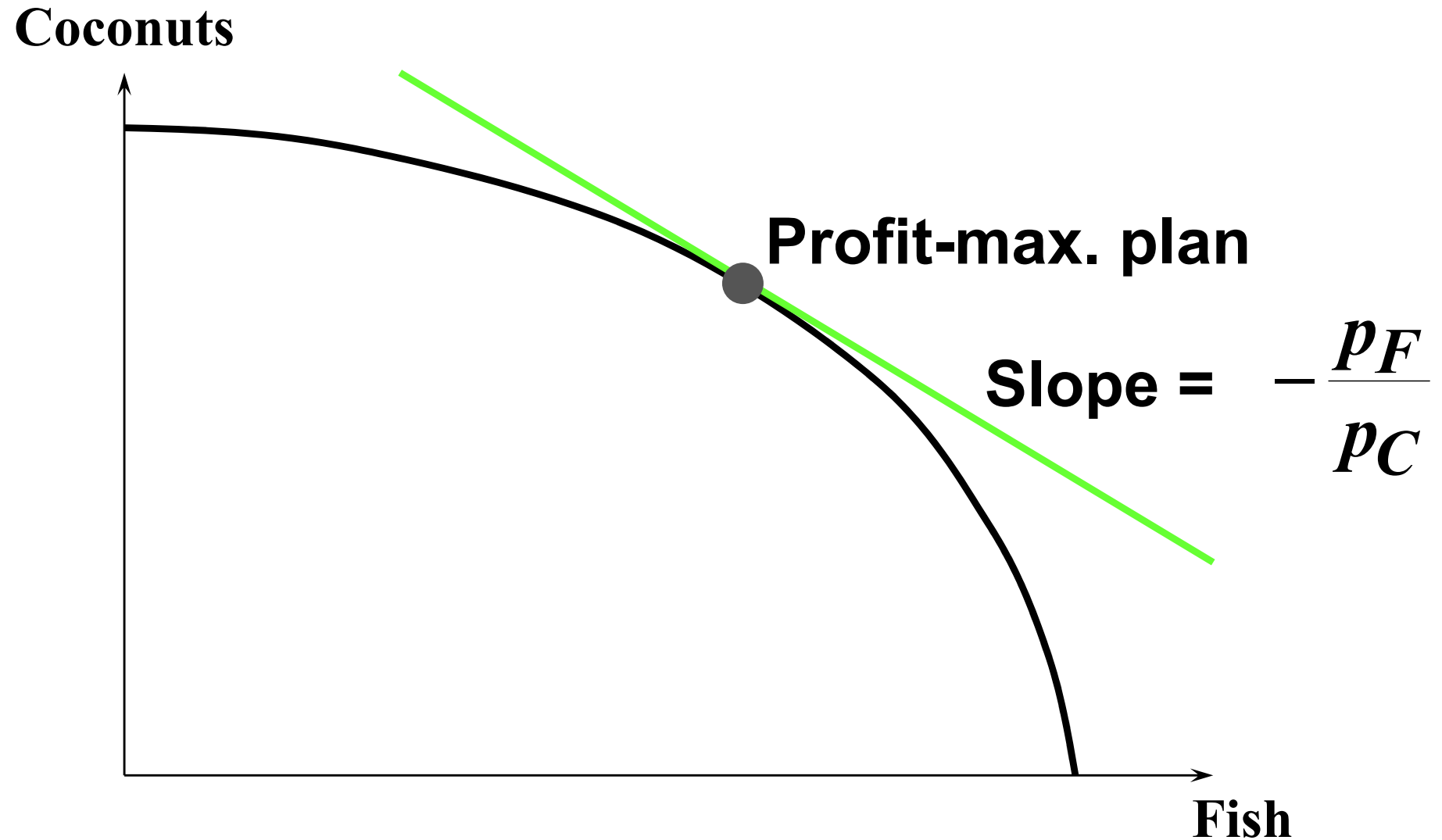


Decentralized Coordination of Production & Consumption

Coconuts

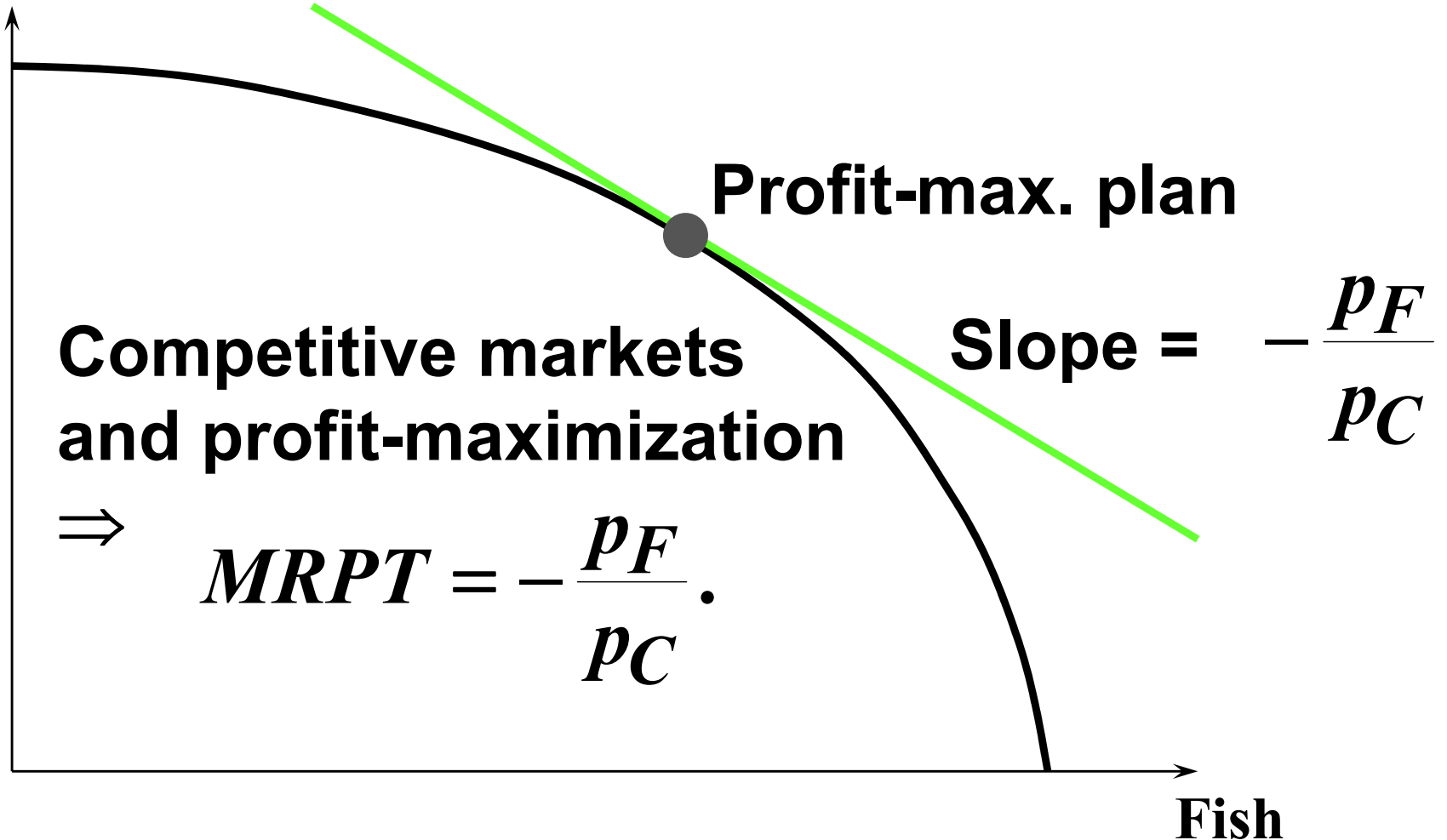


Decentralized Coordination of Production & Consumption



Decentralized Coordination of Production & Consumption

Coconuts



Decentralized Coordination of Production & Consumption

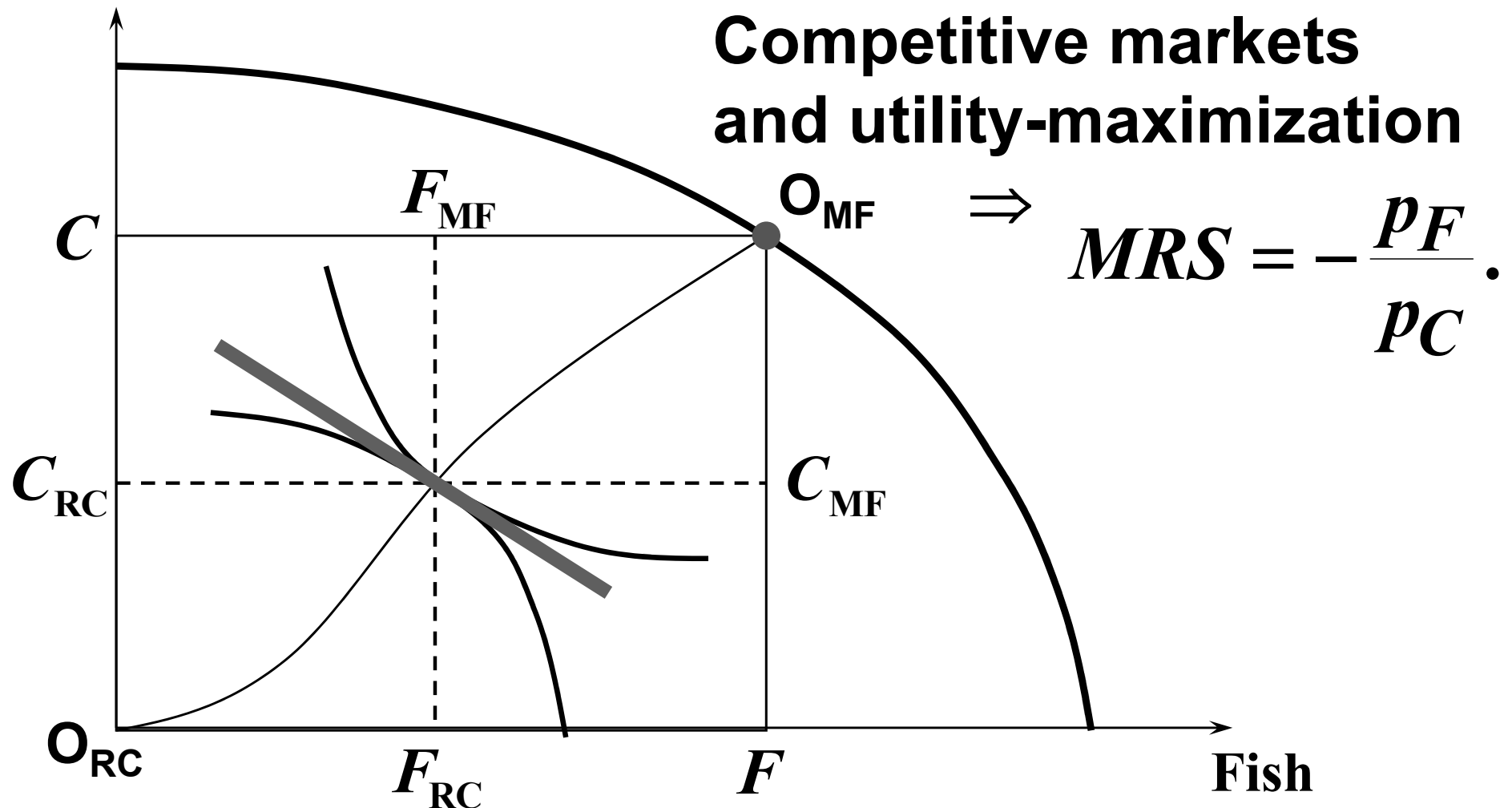
- ◆ **So competitive markets, profit-maximization, and utility maximization all together cause**

$$MRPT = -\frac{p_F}{p_C} = MRS,$$

the condition necessary for a Pareto optimal economic state.

Decentralized Coordination of Production & Consumption

Coconuts



Decentralized Coordination of Production & Consumption

