Consumer Surplus

ECON 370: Microeconomic Theory

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Adding Production

- There will be a Production Sector
  - Defined by some production function
- And Consumers with preferences and endowments
  - Usually assume they are endowed with labor/leisure and (sometimes) Capital
- Consumers own the production firms
  - So all profits are distributed back to the consumers in some way
- Markets and prices
  - We assume there are factor markets for labor and capital
  - And consumer markets for the produced good(s)
  - And market prices for all factors and produced goods

# Adding Production (cont)

- Consumers and firms decide how much to demand/supply of inputs/outputs based on
  - Profit maximization for firms
  - Utility maximization for consumers
  - Market prices
- We are interested in:
  - Efficiency in production
  - Overall economic efficiency

Robinson Crusoe's Economy: Intro

- One agent, *RC*, endowed w/ a fixed qty of one resource, Time = 24 hrs
- Can use time for
  - labor (production) or
  - leisure (consumption)
- Labor time = L
- Leisure time = $24 - L$
- What will RC choose?

1

Robinson Crusoe's Technology: Graph

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

Coconuts

Production function

Feasible production plans

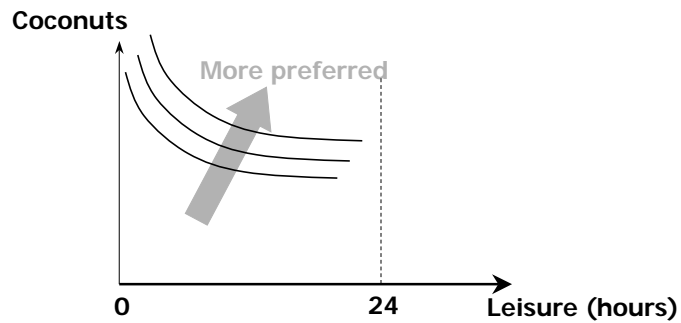**0**   **24**   **Labor (hours)**
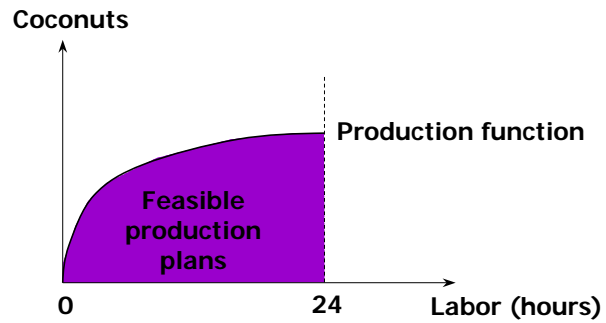
Robinson Crusoe's Preferences

- To represent RC's preferences:
  - coconut is a good
  - leisure is a good

- Yields standard indifference map with leisure

- Yields indifference curves with positive slopes if plot labor (bad)

Robinson Crusoe's Preferences: Graph
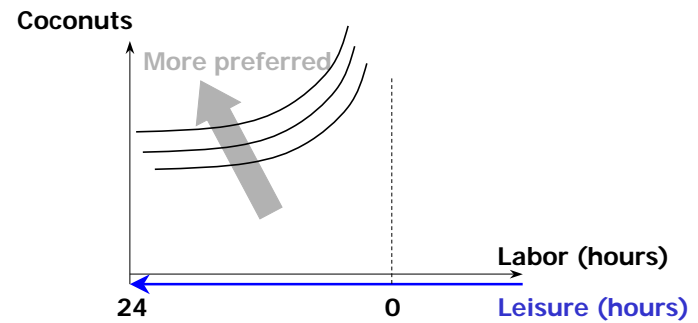
Coconuts

More preferred

0   **24**   **Leisure (hours)**

Robinson Crusoe's Preferences: Graph

Coconuts

More preferred

Labor (hours)

24   **0**   **Leisure (hours)**

2

Robinson Crusoe's Choice: Graph

Coconuts

C^*

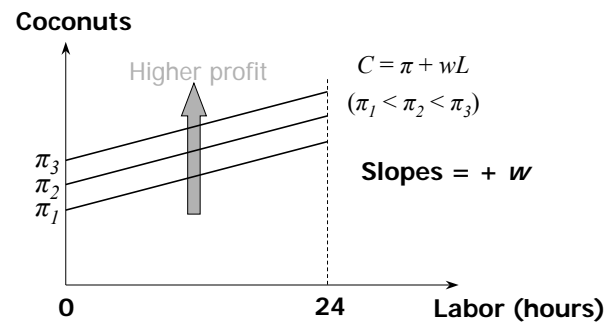**Labor (hours)**

0   L^* 24   **Leisure (hours)**
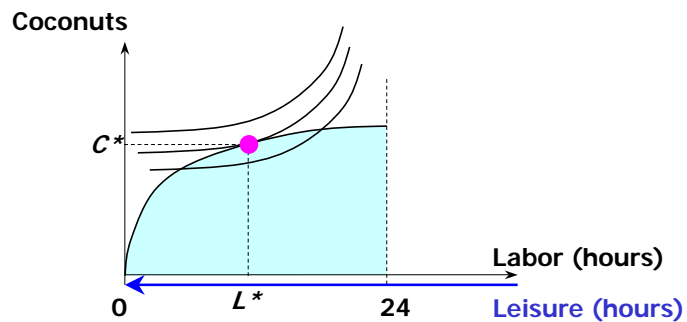
Schizophrenic Robinson Crusoe

- Now suppose RC is both
  - a utility-maximizing consumer and
  - a profit-maximizing firm
  - And decides separately how much to produce or consume

- Use coconuts as the numeraire good
  - So, 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 $\pi = C - wL$

- Isoprofit line equation is

- $\pi = C - wL \Leftrightarrow C = \pi + wL,$ in C-L space

- Slope = $+ w$

- Intercept = π

Isoprofit Lines: Graph

Coconuts

Higher profit

$C = \pi + wL$

$(\pi_1 < \pi_2 < \pi_3)$

π_3
π_2
π_1

Slopes = $+ w$

0   24   **Labor (hours)**

3

Profit-Maximization: Graph

- At optimum:
  - Isoprofit slope = production function slope
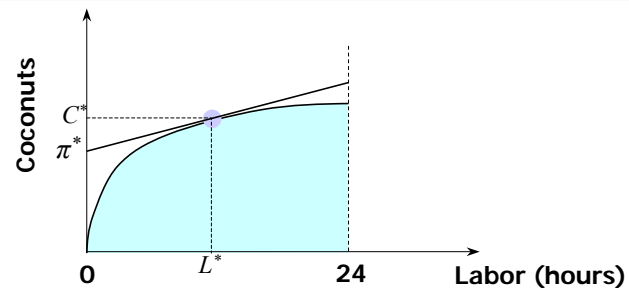 - That is, $w = p \times MP_L = 1 \times MP_L = MRP_L$

Coconuts

Production function

π_3
π_2
π_1

0   **24**   **Labor (hours)**
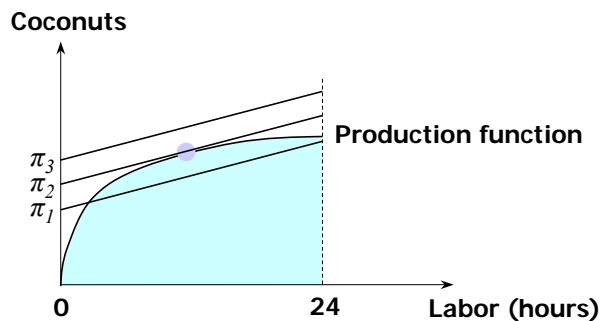
Profit-Maximization: Graph

- As a firm, at wage w Robinson:
  - demands Labor L^*
  - Produces C^* coconuts
  - Gets $\pi^* = C^* - wL^*$ in dividends from the firm

Coconuts

C^*
π^*

0 L^* **24**   **Labor (hours)**
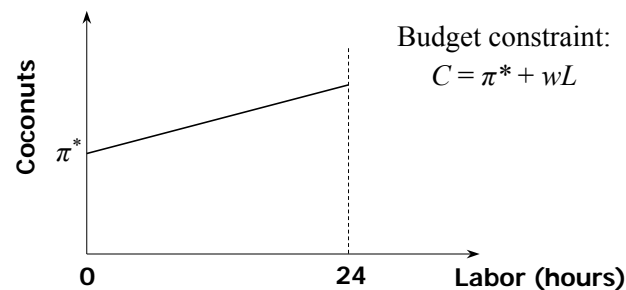
Utility-Maximization: Introduction

- Now consider RC as a consumer endowed with $\$\pi^*$, who can work for $\$w$ per hour

- What is RC's most preferred consumption bundle?

- Budget constraint is:

$$C = \pi^* + wL$$

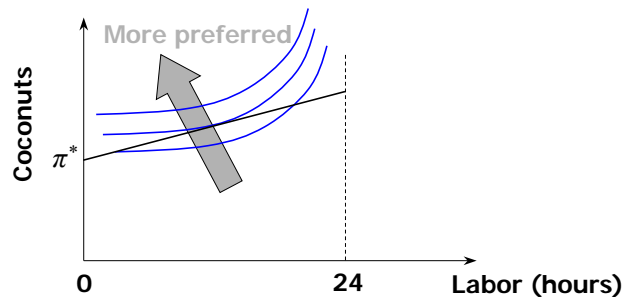## Utility-Maximization: Budget Constraint

Coconuts

Budget constraint:
$C = \pi^* + wL$

π^*

0   **24**   **Labor (hours)**

4

Utility-Maximization: Preferences

More preferred

Coconuts

π^*

0   24   **Labor (hours)**
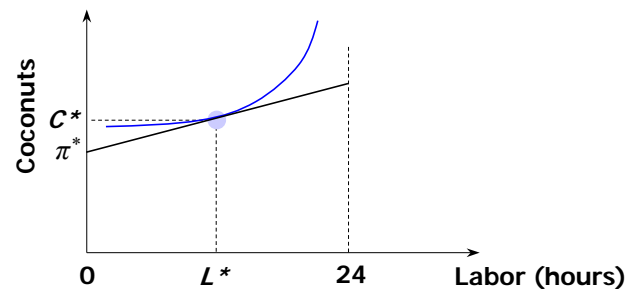
Utility-Maximization: Choice

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

Coconuts
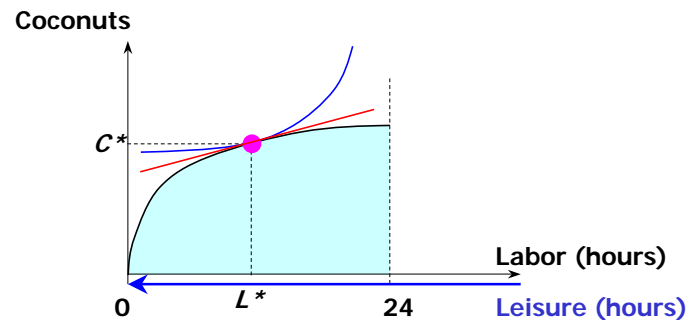
C^*
π^*

0   L^* 24   **Labor (hours)**

Output and Factor Markets Clear

- Price is determined based on the requirement that all markets clear

- That is:
  - quantity output supplied = quantity output demanded
  - quantity labor demanded = quantity labor supplied

- If we have:
  - well-behaved preferences, and
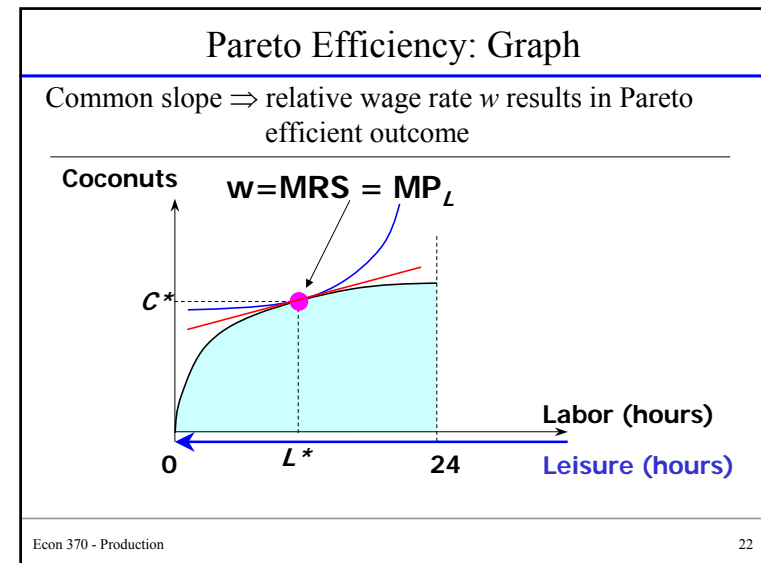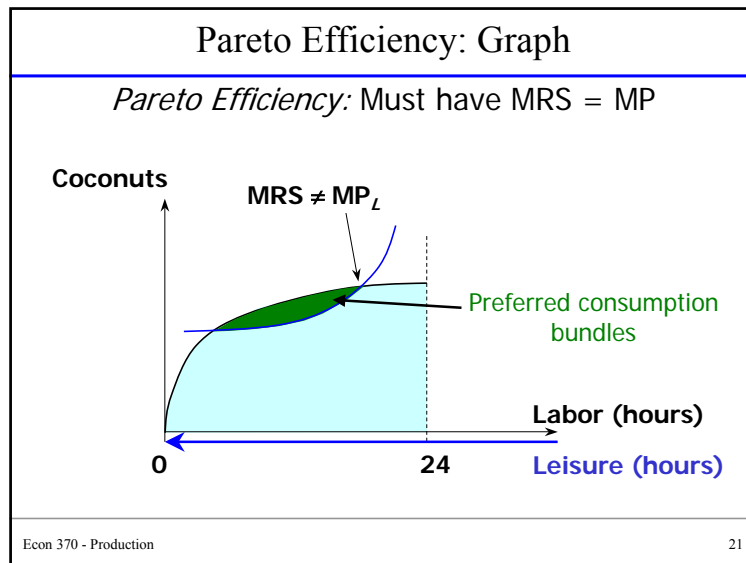 - Convex production function

- Then such a price exists

Utility and Profit-Maximization: Graph

Coconuts

C^*

0   L^* 24   **Labor (hours)**

Leisure (hours)

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Pareto Efficiency: Graph

Pareto Efficiency: Must have MRS = MP

Coconuts

MRS $\neq$ MP$_L$

Preferred consumption bundles

Labor (hours)

0   24   **Leisure (hours)**

Pareto Efficiency: Graph

Common slope $\Rightarrow$ relative wage rate *w* results in Pareto efficient outcome

Coconuts   w=MRS = MP$_L$

C^*

**Labor (hours)**

0   L^* 24   **Leisure (hours)**

Fund. Theorems of Welfare Economics

- 1st 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
- 2nd Fundamental Theorem of Welfare Economics
  - Any Pareto efficient outcome can be achieved as a competitive market equilibrium if:
  - the appropriate redistribution of endowments occurs
  - consumers' preferences are convex
  - there are no externalities in consumption or production
  - firms' technologies are convex
- Note convex firm technology rules out increasing returns to scale

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Extend to Two-Good Economy

- Consider RC economy with two goods
  - Coconuts and fish
  - Both require labor to be produced
  - Will now consider production possibilities of two good economy

Production Possibilities: Introduction

- Resource and technological limitations restrict what an economy can produce

- *Production possibility set* - set of all feasible output bundles

- *Production possibility frontier* - the outer boundary of the production possibility set

Production Possibilities: Graph

Production possibility frontier (ppf)
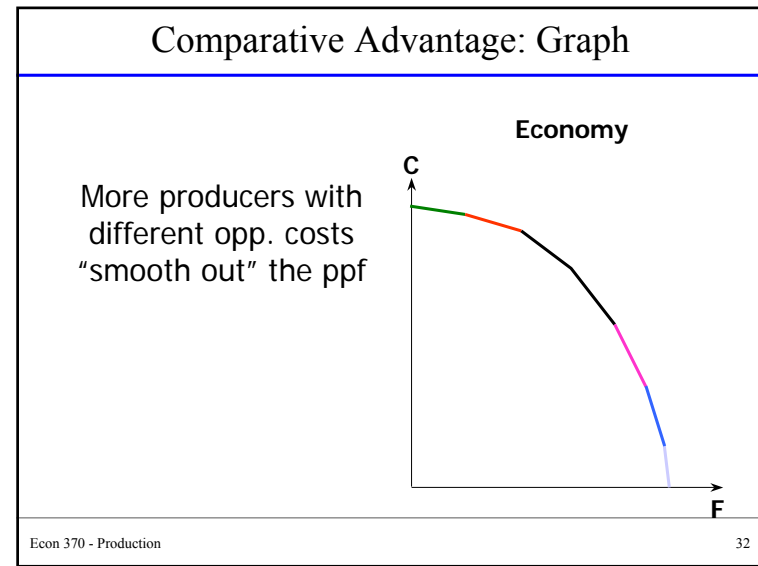
Coconuts

Production possibility set
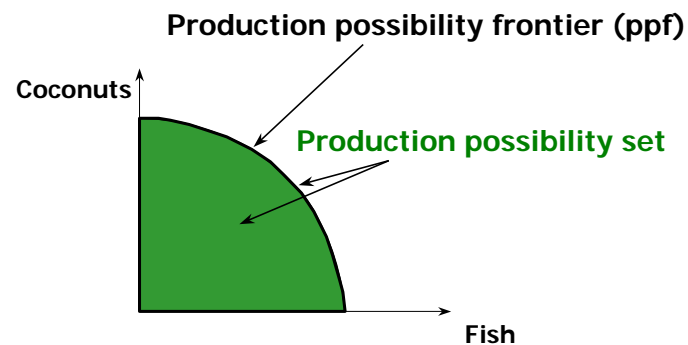
Fish

Production Possibilities: Graph

Marginal rate of transformation (MRT) = PPF's slope
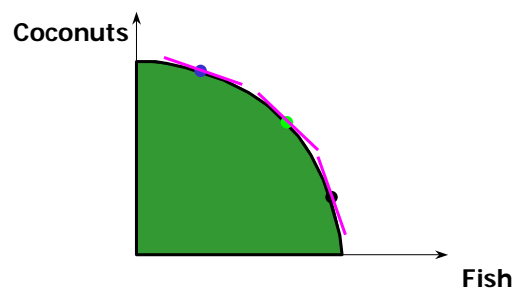
Coconuts

Fish

Comparative Advantage: Introduction

- Two agents, RC and Man Friday (MF)

- Assume linear production technologies

- RC can produce at most 20 coconuts or 30 fish

- MF can produce at most 50 coconuts or 25 fish

- RC has comparative advantage in producing fish

- PPF is concave w.r.t. origin because take advantage of comparative advantages in production

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Comparative Advantage: Graph

C

20

RC   30   F

C

50

MF   25   F

- Two agents, RC and MF
- RC can produce at most 20 coconuts or 30 fish
- MF can produce at most 50 coconuts or 25 fish

Combined Graph

C

20

RC   30   F

C

50

MF   25   F

Economy

C

70

50

Use RC to produce fish before using MF

Use MF to produce coconuts before using RC

30   55   F

Comparative Advantage: Graph

C

20

RC   30   F

C

50

MF   25   F

Economy

C

70

50

Using low opp. cost producers first results in a ppf that is *concave* w.r.t the origin

30   55   F

Comparative Advantage: Graph

More producers with different opp. costs "smooth out" the ppf

Economy

C

F

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Decentralized Coordination

- RC and MF run the firm(s) producing coconuts and fish
- And receive the dividends distributing the profits
- 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

- L_{RC} and L_{MF} are amounts of labor purchased from RC and MF
- Firm's profit-maximization problem is to 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

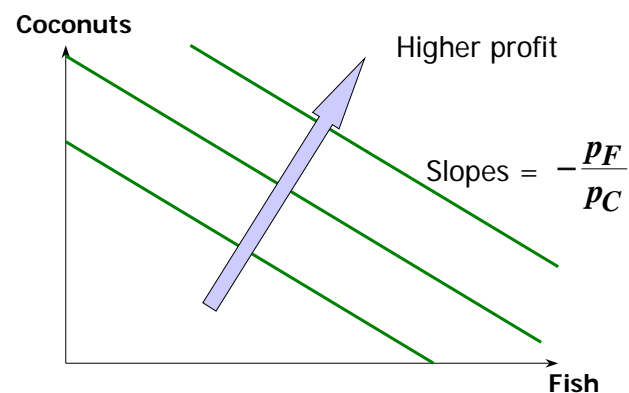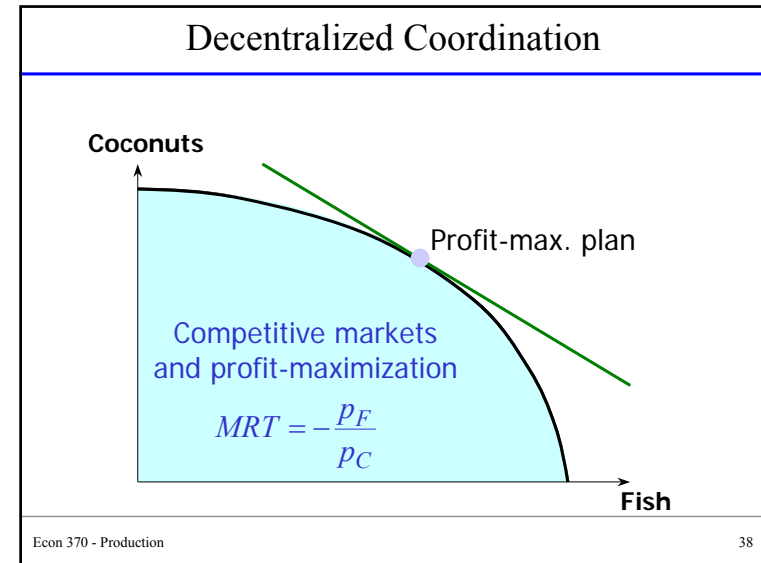$$\max \pi = p_C C + p_F F - w_{RC} L_{RC} - w_{MF} L_{MF}$$
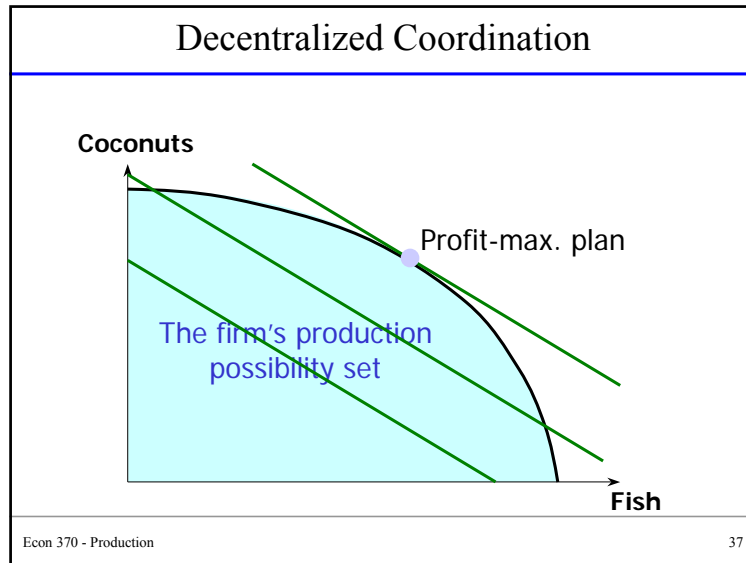
Isoprofit line equation is

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

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

Coconuts

Higher profit

Slopes $= -\dfrac{p_F}{p_C}$

Fish

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Decentralized Coordination

Coconuts

Profit-max. plan

The firm's production possibility set

Fish

Decentralized Coordination

Coconuts

Profit-max. plan

Competitive markets and profit-maximization

$$MRT = -\frac{p_F}{p_C}$$

Fish

Decentralized Coordination

- Competitive markets, profit-maximization, and utility maximization all together cause
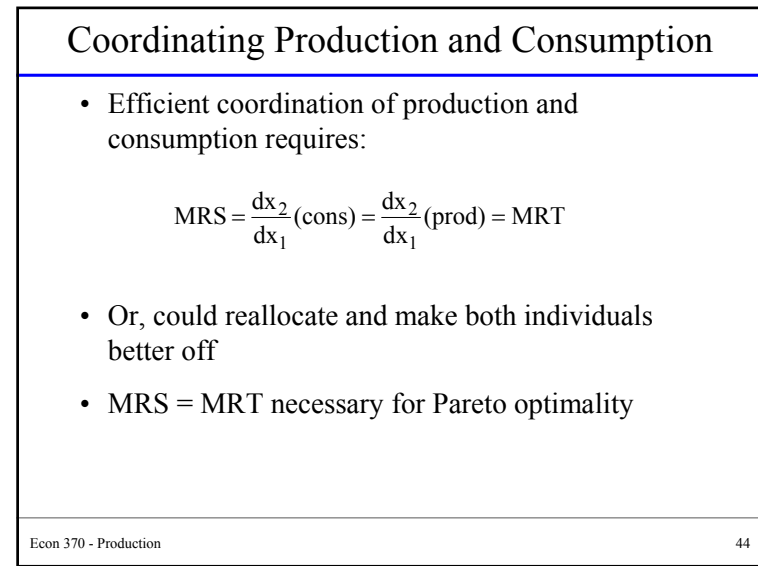
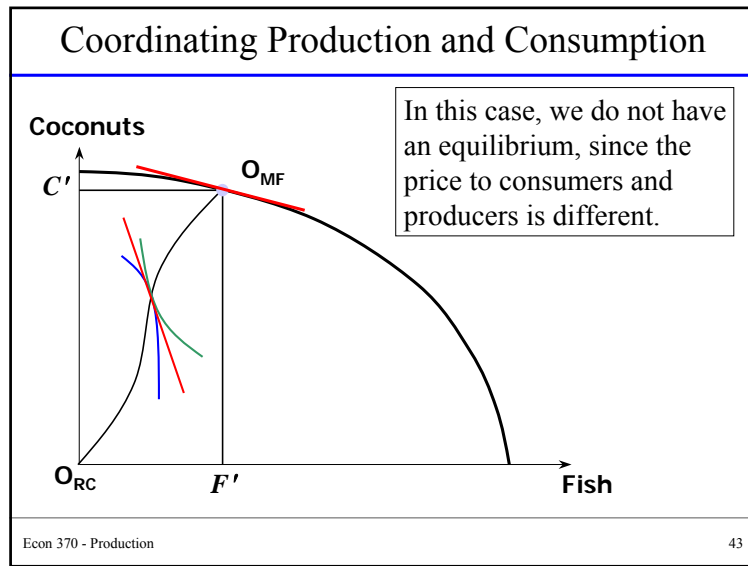$$MRPT = -\frac{p_F}{p_C} = MRS$$

- This is the condition necessary for a Pareto optimal economic state

Coordinating Production and Consumption

- The *PPF* contains many technically efficient output bundles

- Which are Pareto efficient for consumers?

- As before, those where
  - If both consumers and producers face the same price,
  - Markets clear

- Alternatively,
  - Given that markets clear,
  - Both consumers and producers face the same price

Coordinating Production and Consumption

Suppose for given prices output bundle (F', C') Maximized profits

Coordinating Production and Consumption

The production bundle forms an Edgeworth Box for the two consumers, with wages and dividends forming the endowment

Coordinating Production and Consumption

In this case, we do not have an equilibrium, since the price to consumers and producers is different.

Coordinating Production and Consumption

- Efficient coordination of production and consumption requires:

$$MRS = \frac{dx_2}{dx_1}(cons) = \frac{dx_2}{dx_1}(prod) = MRT$$

- Or, could reallocate and make both individuals better off

- MRS = MRT necessary for Pareto optimality

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Coordinating Production and Consumption

Coconuts

C'

O_{MF}

O_{RC} F' **Fish**