EE311:
General Equilibrium Analysis

Key Assumptions

In the following analysis, we will assume that all markets in consideration are **perfectly competitive**.

This is when the markets have
- Many Buyers and Sellers who are all Price-Takers
- No Barriers to Entry and Exit
- Perfect Information / Perfect Knowledge
- No Transaction Costs
- No Externalities

Partial Equilibrium and General Equilibrium

Definition: **Partial Equilibrium analysis** is the study of how equilibrium is determined in only a single market (e.g. a single product market).

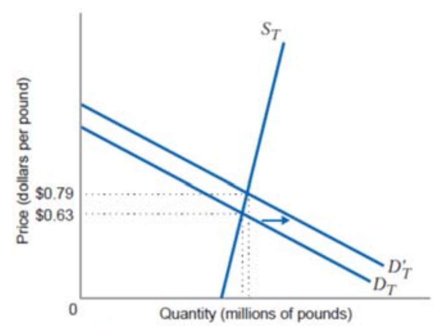
In such analysis, we focus on the equilibrium price one good, taking as given the prices of all other goods.

Definition: **General Equilibrium analysis** is the study of how equilibrium is determined in all markets simultaneously (e.g. product markets and labor markets).

Note that these markets must be related somehow.

Partial Equilibrium – Example

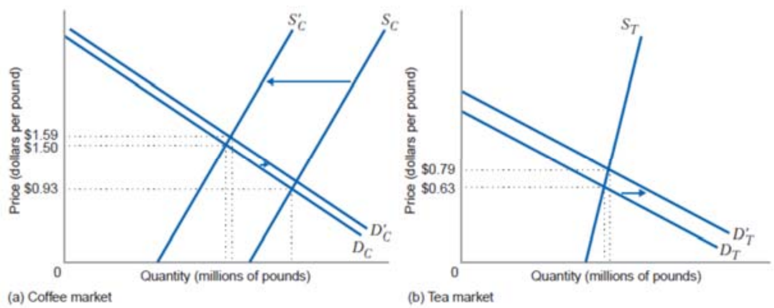
Suppose there is a report saying that drinking tea is good. As a result, the demand of tea rises. In the tea market, the equilibrium price and quantity of tea is now higher.



(b) Tea market

General Equilibrium – Example

<u>Suppose bad weather affects coffee crops.</u> The supply of coffee falls, raising its equilibrium price. **Because tea and coffee are substitutes**, this raises the demand for tea and its price. Finally, the higher price of tea raises the demand for coffee a little.



Partial Equilibrium Vs. General Equilibrium

LEARNING-BY-DOING EXERCISE 16.1

Finding the Prices at a General Equilibrium with Two Markets

The following table shows the equations of some of the demand and supply curves depicted in Figure 16.2.

	Initial Demand Curve	Initial Supply Curve	Supply Curve after Frost
Coffee	$Q_C^d = 120 - 50P_C + 40P_T$	$Q_C^s = 80 + 20P_C$	$Q_C^s = 40 + 20P_C$
Tea	$Q_T^d = 80 - 75P_T + 20P_C$	$Q_T^s = 45 + 10P_T$	$Q_T^s = 45 + 10P_T$

Problem

(a) What are the general equilibrium prices of coffee and tea initially?

(b) What are the general equilibrium prices after a frost damages the coffee crop?

a) Coffee: P = 0.93 Tea: P = 0.63
b) Coffee: P = 1.59 Tea: P = 0.79

General Equilibrium: Many Markets

Consider an economy with two types of consumers and goods.

Consumers: Blue-Collar and White-Collar

Goods: Food and Energy

FoP: Labor and Capital.

Hence, there are 4 markets in total:
Markets for Food, Energy, Labor, and Capital.

We will now examine Supply and Demand in each market.

General Equilibrium: Many Markets

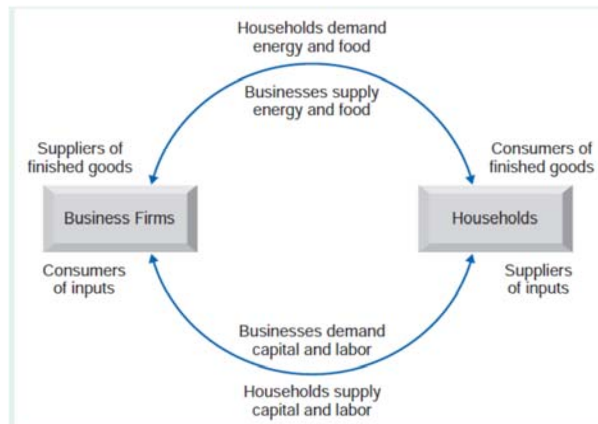


FIGURE 16.4 Interactions between Firms and Households in a General Equilibrium
Households, in their role as consumers of finished goods, purchase the energy and food that are supplied by business firms. Firms, in their role as consumers of inputs, purchase the services of labor and capital that are supplied by households.

4 Boxes represents the 4 components of this economy.
We will now analyze each of these 4 components

General Equilibrium: Many Markets

The First Component: Demand Curves for Food and Energy

The demands for both food and energy come from the households: white-collar and blue-collar.

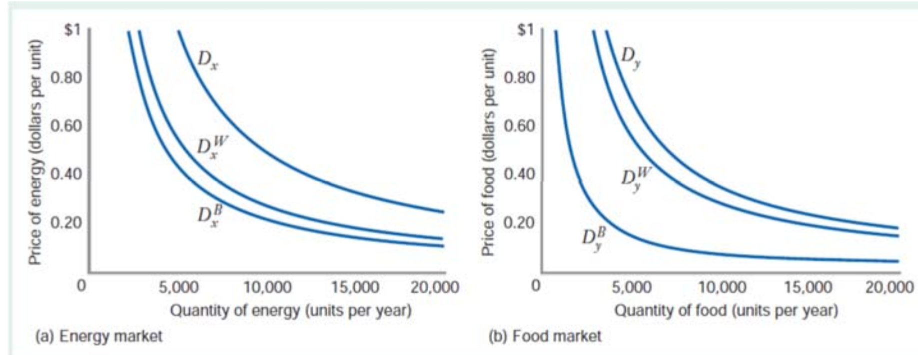
The demand curves are derived from the optimality conditions:

$$MRS^{W}_{x,y} = \frac{P_x}{P_y} \quad \text{and} \quad MRS^{B}_{x,y} = \frac{P_x}{P_y}$$

Thus, the demand curves for food and energy come from utility maximization of households.

General Equilibrium: Many Markets

The First Component: Demand Curves for Food and Energy



General Equilibrium: Many Markets

The Second Component: Demand Curves for Labor and Capital

The demands for both labor and capital come from the firms.

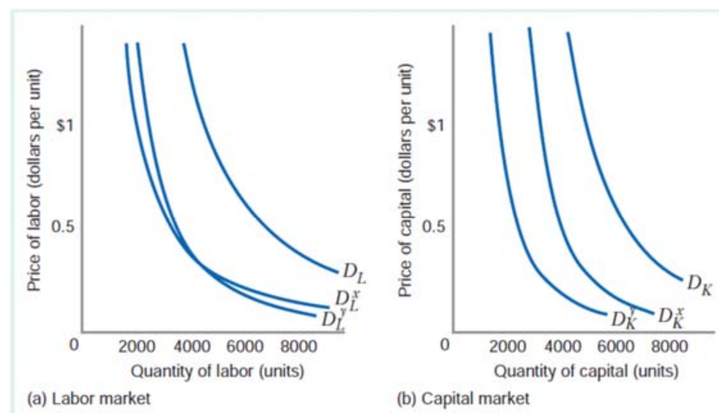
The demand curves are derived from the optimality conditions:

$$MRTS^{x}_{l,k} = \frac{w}{r} \quad \text{and} \quad MRTS^{y}_{l,k} = \frac{w}{r}$$

Thus, the demand curves for labor and capital come from cost minimization of firms.

General Equilibrium: Many Markets

The Second Component: Demand Curves for Labor and Capital



General Equilibrium: Many Markets

The Third Component: Supply Curves for Food and Energy

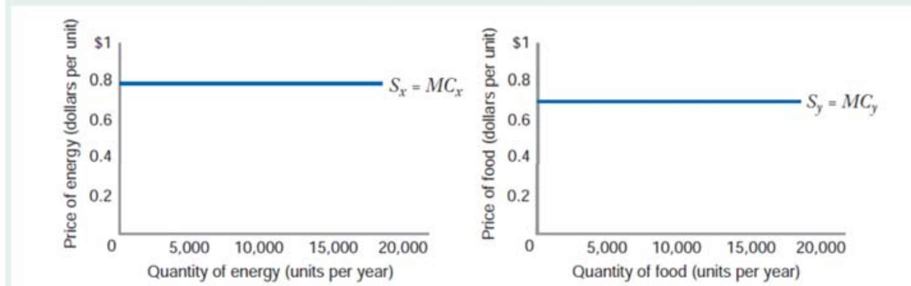
We assume here that the markets for food and energy are perfectly competitive. Hence, the supply curves for both goods are perfectly elastic. Firms can supply as much as they want at the market prices, which equal the marginal costs. **Note that the equilibrium prices must also equal the MCs.**

$$P_x = MC_x \quad \text{and} \quad P_y = MC_y$$

Thus, the supply curves for food and energy come from profit maximization of firms.

General Equilibrium: Many Markets

The Third Component: Supply Curves for Food and Energy



(a) Energy market (b) Food market

General Equilibrium: Many Markets

The Fourth Component: Supply Curves for Labor and Capital

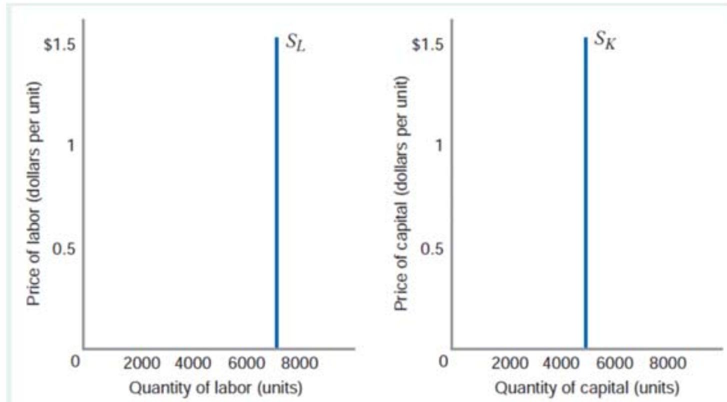
The two factors of productions are provided by households. **Each household can offer a fixed supply of labor and capital.** The households will supply positive amounts of inputs as long as their prices are positive. They will supply inputs in either industries as long as their prices are the same in each industry.

This implies that the supply curves are vertical.

Thus, the supply curves for labor and capital come from profit maximization of households.

General Equilibrium: Many Markets

The Fourth Component: Supply Curves for Labor and Capital



(a) Labor market (b) Capital market

General Equilibrium: Many Markets

The General Equilibrium occurs when all markets are in equilibrium. This implies that

In the two goods markets,

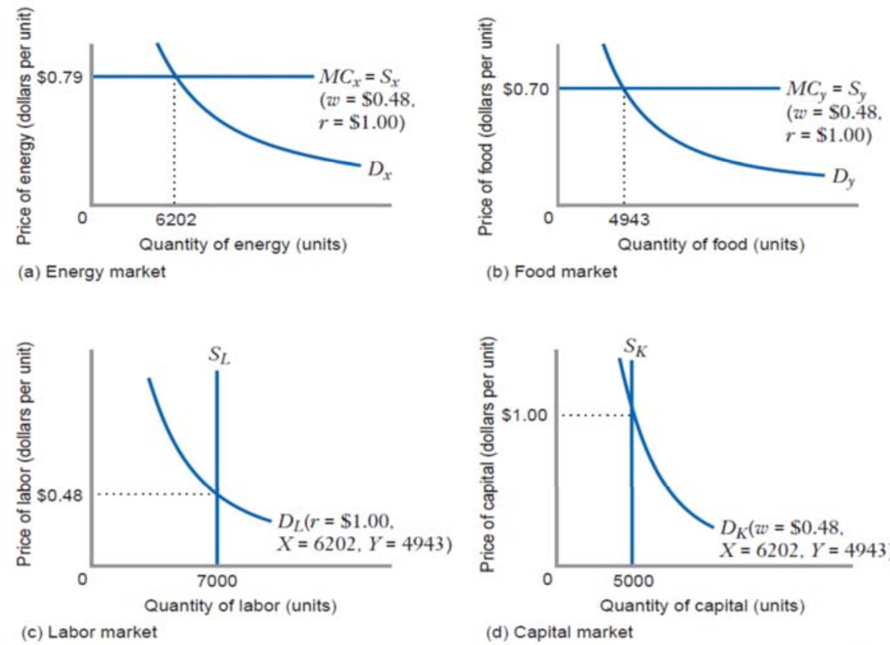
Household Demand for Energy = Firm Supply of Energy

Household Demand for Food = Firm Supply of Food

In the two factor markets,

Firm Demand for Labor = Household Supply of Labor

Firm Demand for Capital = Household Supply of Capital



LEARNING-BY-DOING EXERCISE 16.2

Finding the Conditions for a General Equilibrium with Four Markets

Suppose that the households in the simple economy depicted in Figure 16.9 have the characteristics given in the following table:

	Number of Households	Labor Supplied per Household	Capital Supplied per Household	Household Income
Blue Collar	100	60 units	0 units	$I_B(w, r) = 60w$
White Collar	100	10 units	50 units	$I_W(w, r) = 10w + 50r$

Also suppose that the supply and demand curves for the markets in this economy are as shown in the following table, where X is the overall quantity of energy demanded and Y is the overall quantity of food demanded:[4]

	Energy	Food	Labor	Capital
Supply	$P_x = w^{\frac{1}{3}} r^{\frac{2}{3}}$	$P_y = w^{\frac{1}{2}} r^{\frac{1}{2}}$	$L = 7000^*$	$K = 5000^*$
Demand	$P_x = \frac{50I_W + 75I_B}{X}$	$P_Y = \frac{50I_W + 25I_B}{Y}$	$L = \frac{X}{3}\left(\frac{r}{w}\right)^{\frac{2}{3}} + \frac{Y}{2}\left(\frac{r}{w}\right)^{\frac{1}{2}}$	$K = \frac{2X}{3}\left(\frac{w}{r}\right)^{\frac{1}{3}} + \frac{Y}{2}\left(\frac{w}{r}\right)^{\frac{1}{2}}$

Problem

(a) What are the supply-equals-demand conditions for the energy and food markets?

(b) What are the supply-equals-demand conditions for the labor and capital markets?

(c) How would we find the general equilibrium for this economy?

Walras' Law

<u>**Walras's Law**</u> states that the sum of the values of excess demands across all markets must equal zero.

This implies that if positive excess demand exists in one market, negative excess demand must exist in some other market.

Thus, if all markets <u>except one</u> are in equilibrium, then that last market must also be in equilibrium.

To illustrate, suppose there are N markets. If S = D in the first N – 1 markets, then S = D in the Nth market as well.

<u>We can use this law to simplify calculation in Exercise 16.2.</u>

General Equilibrium: Many Markets

Suppose the government imposes tax on energy and give this tax money as food coupon so that people can buy food.

What is the effect of tax on the economy?

We can use **Walras' Law** to assume that the capital market is in equilibrium, and focus only on food, energy, and labor markets.

General Equilibrium: Many Markets

Higher Tax >>> D_{energy} falls >>> D_{labor} falls

Food Coupon >>> D_{food} rises >>> D_{labor} rises

Since food production requires more labor than energy, we can assume that **D_{labor} rises more than it falls**.

D_{labor} rises >>> higher wage >>> S_{food} falls
>>> S_{energy} falls

Overall Effect
(new general equilibrium)

	Energy	Food	Labor
Price	Up	Up	Up
Quantity	Down	Up	Unchanged

Economic Efficiency

General equilibrium implies that markets determine allocation of goods and inputs.

We say that such allocation is **Economically Efficient** **(or Pareto Efficient) IF there is no feasible allocation of goods and inputs that can make someone better off without making someone else worse off.**

Economic Efficiency

Economic Efficiency requires 3 conditions:

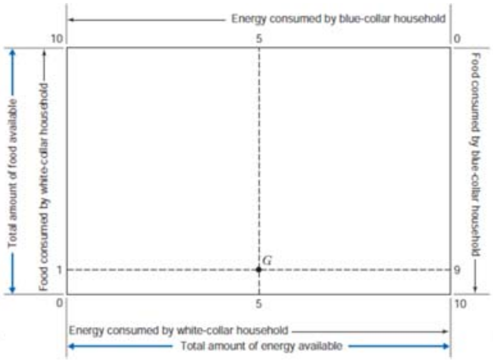
1) **Exchange Efficiency** – when a fixed amount of goods cannot be reallocated among consumers to make someone better off without making someone else worse off.

2) **Input Efficiency** – when a fixed amount of inputs cannot be reallocated among firms to increase production of one good without reducing production of another good.

3) **Substitution Efficiency** – when a fixed amount of inputs cannot be reallocated to make everyone better off by producing more of one good and less of another.

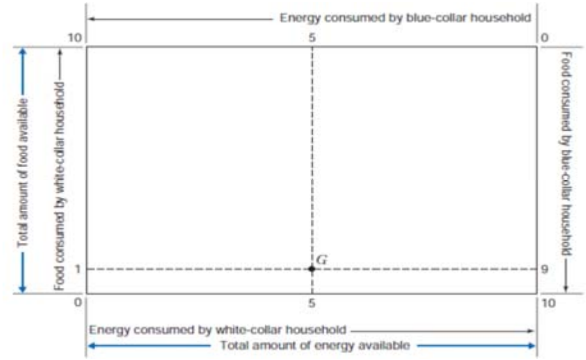
Economic Efficiency – Edgeworth Box

We use Edgeworth Box to analyze Economic Efficiency.
Edgeworth Box shows all the possible allocation of two goods in the economy, given the total available supply of each good.

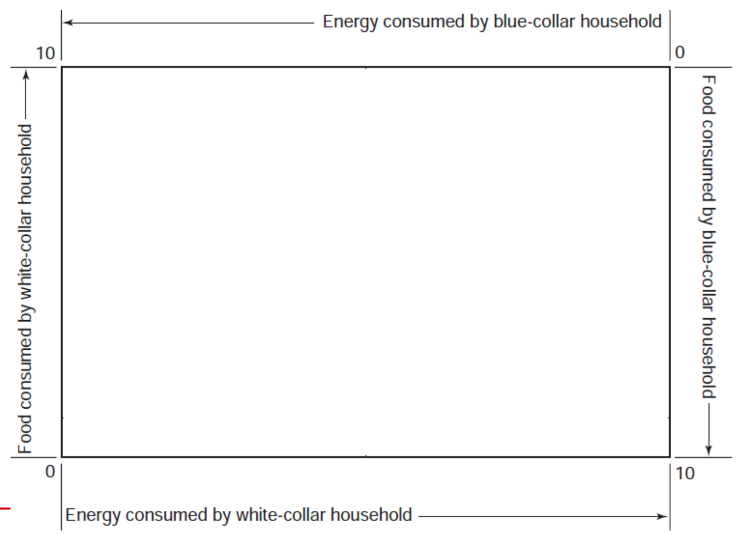


Economic Efficiency – Edgeworth Box

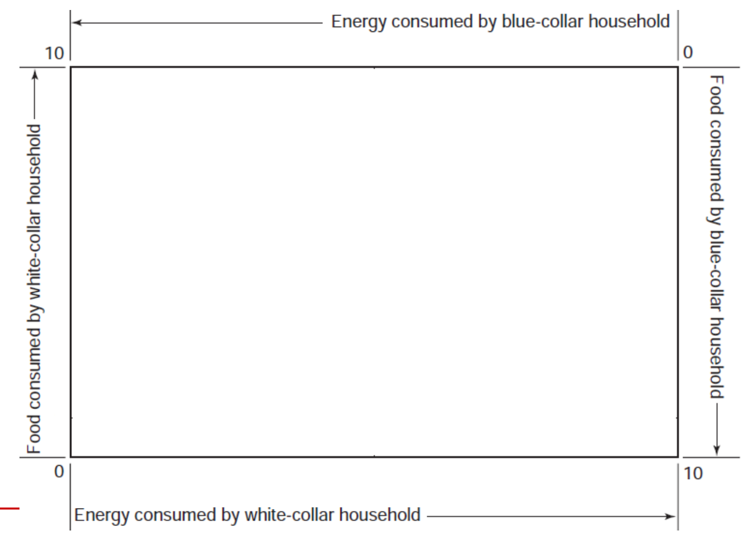
In this economy, 10 food and 10 energy are available.
At Point G, Blue-collar consume 5 energy and 9 food
White-collar consume 5 energy and 1 food.



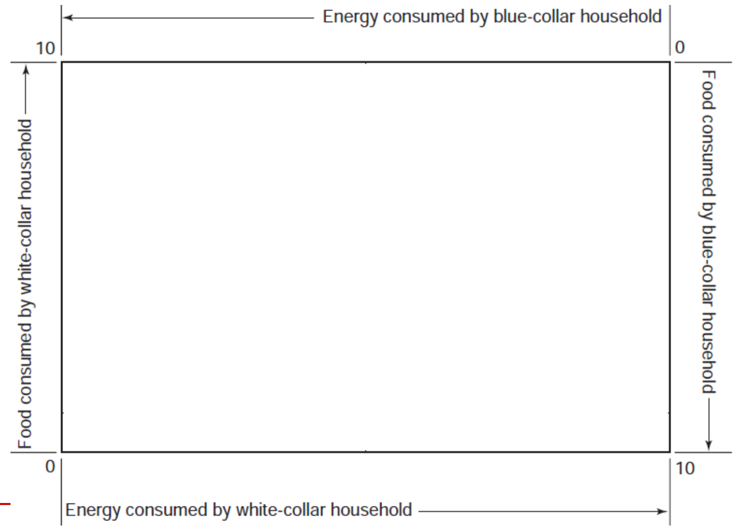
Indifference Curves of White-Collar



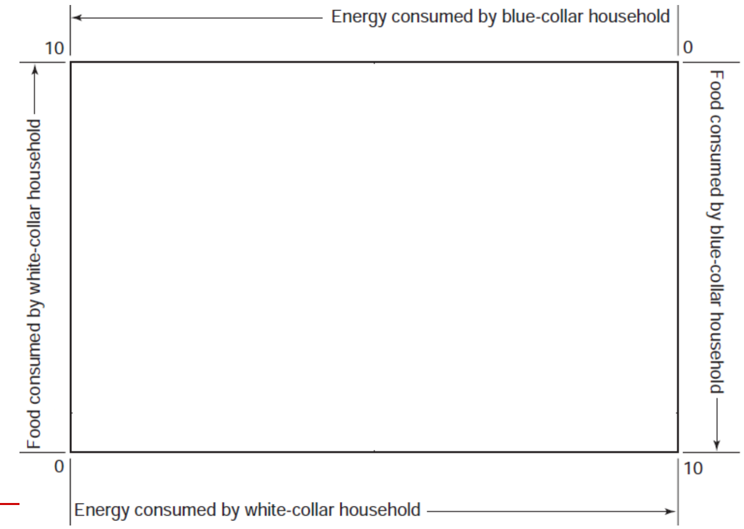
Indifference Curves of Blue-Collar



Exchange Inefficient Allocation (point Y)



Exchange Efficient Allocation (point X)



Exchange Efficiency and Contract Curve

Point Y is not an exchange-efficient allocation.

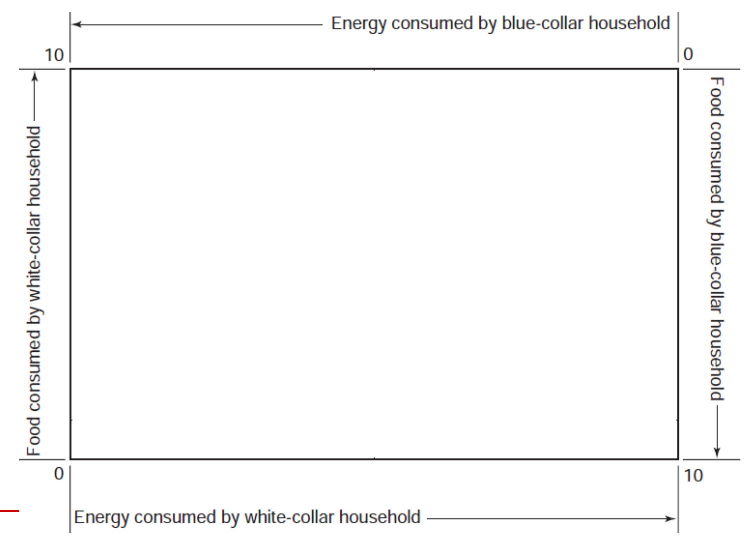
At Y, there are potential trades/exchanges among consumers that would benefit all consumers.

Point X is an exchange-efficient allocation.

At X, there are NO trades/exchanges among consumers that would benefit all consumers.

A **Contract Curve** shows all the allocations of goods in an Edgeworth Box that are economically efficient.

Contract Curve (linking all exch. eff. all.)



Exchange Efficiency

Condition for Exchange Efficiency (Efficiency in Consumption)

$$MRS_{X,Y}^{White} = MRS_{X,Y}^{Blue} = \frac{P_X}{P_Y}$$

Note: X denotes Energy and Y denotes Food.

1. MRSx,y = Px/Py implies that both consumers are maximizing their utility.

2. $MRS^{White} = MRS^{Blue}$ implies exchange efficiency, i.e. there are no unexploited gains from trade between households.

Exchange Efficiency

$MRS^{white} = MRS^{blue}$ implies exchange efficiency. WHY?
For example, **at Point Y**, suppose $MRS^{white} = 1$ and $MRS^{blue} = 2$.

Note MRSx,y = |dy/dx| = |Slope of Indifference Curve|

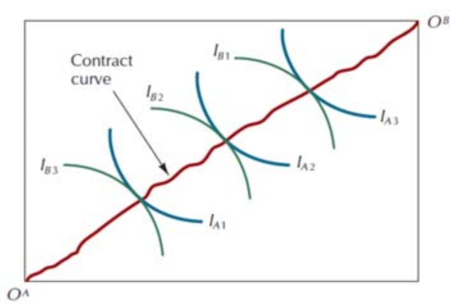
$MRS^{white} = 1$ means that white-collar is willing to sacrifice 1 unit of Y for 1 unit of X.
$MRS^{blue} = 2$ means that blue-collar is willing to sacrifice 2 units of Y for 1 unit of X.

Clearly, blue-collar values X more than white-collar.
At Point X, blue-collar has given some Y to white-collar, while white-collar has given some X to blue-collar. Both are better off.

Contract Curve

A **Contract Curve** shows all the allocations of goods in an Edgeworth Box that are economically efficient.

If the two households were free to bargain and trade, and if all their trades were mutually beneficial, they would bargain their way to an allocation that was on the contract curve.



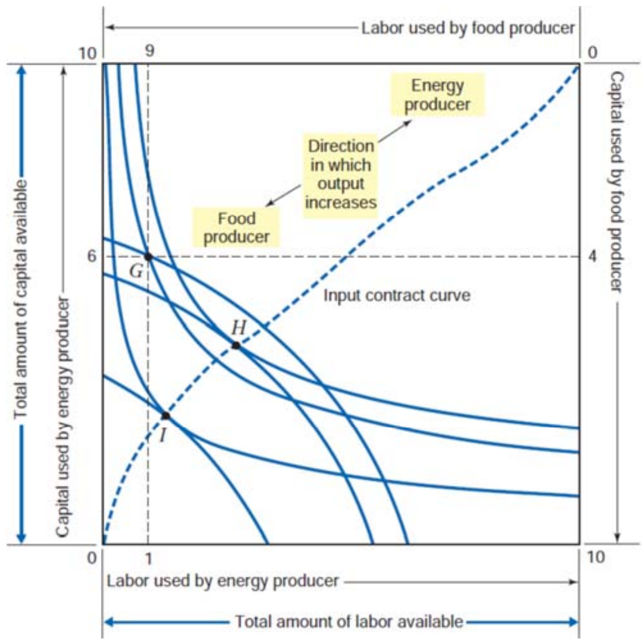
Input Efficiency

Exchange Efficiency concerns consumption.
Input Efficiency concerns production.

Instead of having two consumers, **we have two producers: energy producer and food producer.**

Instead of indifference curves, **we now have isoquant curves,** with labor and capital as factors of production.

An **Input Contract Curve** then shows all the allocations of inputs in an Input Edgeworth Box that are input efficient.



Input Efficiency

Condition for Input Efficiency (Efficiency in Production)

$$MRTS_{L,K}^{Energy} = MRTS_{L,K}^{Food} = \frac{w}{r}$$

1. $MRTS_{L,K} = w/r$ implies that both producers are minimizing their cost.

2. $MRTS^{Energy} = MRTS^{Blue}$ implies input efficiency, i.e. there are no unexploited gains from reallocation of inputs between producers.

Input Efficiency implies that the production is ON the PPF.

Input Efficiency

$MRTS^{Energy} = MRTS^{Food}$ implies input efficiency. WHY?
For example, **at Point G**, let $MRTS^{Energy} = 2$ and $MRTS^{Food} = 1$.

Note $MRTS_{L,K}$ = |dK/dL| = |Slope of Isoquant|

$MRTS^{Energy} = 2$ means that Energy Producer is willing to replace 2 units of K with 1 unit of L.
$MRTS^{Food} = 1$ means that Food Producer is willing to replace 1 unit of K for 1 unit of L.

Energy Producer needs more L than Food Producer does.
At Point H, Energy Producer has given some K to and receive some L from Food Producer. More outputs are now produced.

Substitution Efficiency

Exchange Efficiency concerns consumption.
Input Efficiency concerns production.
Substitution Efficiency combines the two conditions above.

This is because **we may have both exchange efficiency and input efficiency, but the goods produced may not reflect the consumers' needs.**

For example, the economy now spends all resources of energy.
It is clear that all people will be better off if more food is made.

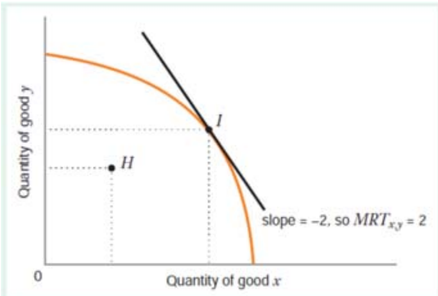
To illustrate this concept, we use the PPF.

Substitution Efficiency

Input Efficiency requires **production on the PPF**.
Substitution Efficiency requires

MRT or Slope of PPF = MRS or Slope of IC

MRT or **Marginal Rate of Transformation** is the slope of PPF.



Substitution Efficiency

Condition for Substitution Efficiency (Efficiency in Allocation)

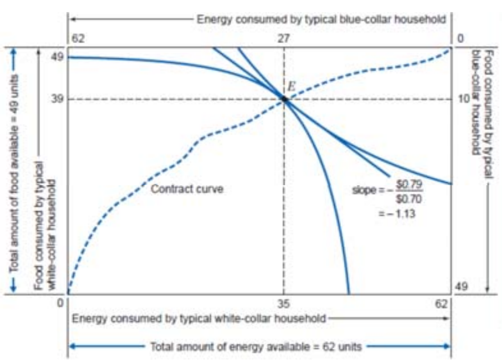
$$MRT_{X,Y} = MRS_{X,Y}^{White} = MRS_{X,Y}^{Blue}$$

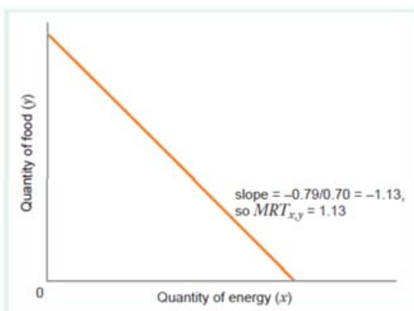
MRT = MRS implies MCx/MCy = MUx/MUy

Rearranging, we have $\frac{MUx}{MCx} = \frac{MUy}{MCy}$.

That is, the substitution efficiency is such that **one dollar spent on X gives the same MU as one dollar spent on Y.**
If $MRS_{X,Y}$ > $MRT_{X,Y}$, the economy should produce more X and less Y, and household utility would go up.

Substitution Efficiency





Competitive General Equilibrium

In the partial equilibrium with one market, a competition in that market ensures efficient allocation of resources.

This is the same as in the general equilibrium case.

When **ALL markets are competitive**, then P = MC.

$$MRS_{X,Y}^{White} = MRS_{X,Y}^{Blue} = \frac{P_X}{P_Y} = \frac{MC_X}{MC_Y} = MRT_{X,Y}$$

As a result, Exchange Efficiency, Input Efficiency, and Substitution Efficiency are all satisfied.
We can then conclude that we have "Economic Efficiency" in a "Competitive General Equilibrium".

Fundamental Theorems of Welfare

Fundamental Theorems of Welfare concerns **Efficiency and Equity** in the allocation of resources.

First Fundamental Theorem of Welfare (EFFICIENCY)

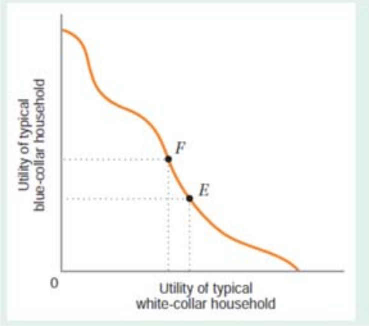
The allocation of goods and inputs in a competitive GE is economically efficient (Pareto efficient).

In other words, given the resources available, there is no other feasible allocation of goods and inputs that could simultaneously make all consumers better off.

Fundamental Theorems of Welfare

Second Fundamental Theorem of Welfare (EQUITY)

Any economically efficient allocation of goods and inputs can be attained as a competitive GE through a **judicious** allocation of the economy's scarce supplies of resources.



Implication
A "Social Planner" may allocate resource such that both blue-collar and white-collar are **EQUALLY** happy, i.e. from E to F.