Muhammad Rahman
Indiana University
Bloomington

CHAPTER-5

A. CONSTRUCTION OF CLOSED ECONOMY MACROMODEL

1) Open Economy Vs Closed economy models

- A Close economy model **does not** allow trade**.**
- An Open economy model **allows** trade.

2) Basic building blocs for a Closed Macro Model

We have three agents in our model:

- **Consumers**: Buys goods and sells labor.
- **Firms**: Buys labor and sells good.
- **Government**: Provides public goods, collects taxes(defense is not included)

B. GOVERNEMENT

1) **Role of the government:** Government in our model only provides **public goods, G** (Roads and highways).
2) **Government's Budget Constraint**: Government has only one **fiscal policy,** to collect tax T and provide public goods G with that money. Therefore, the government's budget constraint looks like:

$$G = T$$

Critical Issue

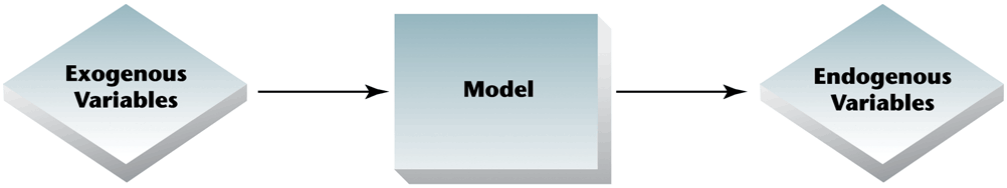
1. Government in our model is given. Hence G is given or **exogenous** (There is no voting). Hence tax T is also **exogenous.**
2. In this model, the government is not allowed to borrow from the private sector. Hence we have a government budget which is an identity.
3. The public good in our model will be provided in terms of goods.

Muhammad Rahman
Indiana University
Bloomington

C. COMPETITIVE EQUILIBRIUM

1) Direction of thought

We are trying to build a model that takes exogenous variables (such as G, T, w) and we are trying to determine value of some endogenous variables (such as C, L, N^d, N^s, π). This is done through a general equilibrium determination for the entire economy. This will be known as the **Competitive equilibrium.**



2) Basic Idea of Competitive Equilibrium

We are trying to define equilibrium for the economy such that:

- Firms and consumers are price takers.
- Consumer's behavior is consistent with firm's behavior.
- Markets clear:
  a) Labor Supply is equal to Labor demand.
  b) Consumption goods consumed by consumers and also by the government are equal to the goods produced by firms.

3) Definition of Competitive Equilibrium

A Competitive Equilibrium is defined as:

- A set of quantities: C, N^s, N^d, T, Y,
- A set of relative prices, w (real wage, i.e. relative price of labor to consumption)

Such that given G, z, and K the following conditions satisfied:

a) **Consumers Maximize Utility**: Given relative prices, w, consumer's choices of C and L maximize its utility subject to its budget constraint.

b) **Firms Maximize Profits**: Given relative prices, w, firm's choices of Y and N maximize its profits.

c) **Markets Clear**:
– Goods market clears, i.e. C + G = Y (where G is exogenous government spending).
– Labor market clears, i.e. $N^d = N^s = h - L$

d) **GBC** is satisfied G = T, taxes paid is equal to government spending

Critical Issue

The Goods market clearing condition is our familiar Income-Expenditure Identity for a closed economy with no Investment

Critical Issue

Q: Why does the Income –Expenditure hold?

Answer: This is because of Walras Law. This law says that if all the agents in the model behave competitively and if the markets clear, then goods market will also clear.

To see this, let's start with the consumer's budget constraint: $C = wN^s + \pi - T$

Profit from the producer is defined as: $\pi = Y - wN^d$

Subbing the value of profit in to consumer's BC: $C = wN^s + Y - wN^d - T$

If we assume that the labor market clears, $N^s = N^d$, and Government satisfies its own budget, T =G, then the consumer's BC:

$$C = Y-G$$
$$C + G = Y$$

D. GRAPHICAL APPROACH TO COMPETITIVE EQUILIBRIUM

1) Motivation

We want to analyze the CE by using graphical approach. This will strengthen our analysis of macroeconomics. This will also help us to highlight the consistency of the behavior of the producer and the consumer in the aggregate economy.

2) Integrating Firm's behavior in Competitive Equilibrium

- In CE, all the markets are in equilibrium. Hence $N^s = N^d = N$ and this helps us define the production technology of the firm as follows:

$Y = zF(K, N)$

- Alternatively, we could integrate the consumer's leisure consumption behavior in the production technology as follows:

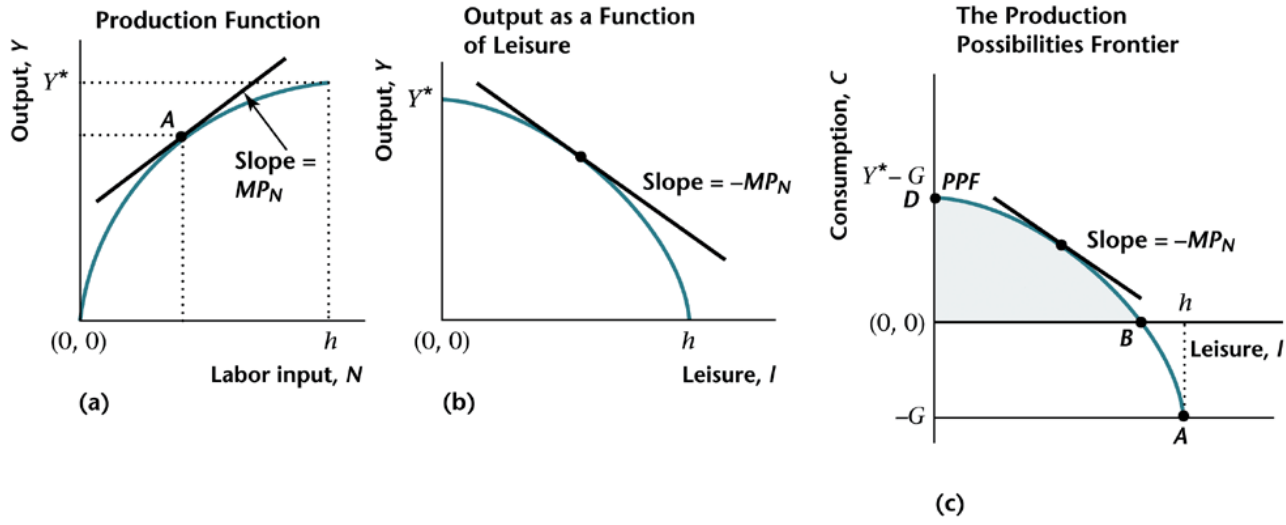
With $N = h - L$, the production function can be written as follows:

$$Y = zF(K, h-L)$$

Muhammad Rahman
Indiana University
Bloomington

- The most convenient(popular) way to integrate consumer and producer's behavior in the economy is substitute the production function in to the consumer's BC:C = zF(K, h-L) – G Graphically this relationship is known as the **Production-Possibility Frontier.**

Figure 5.2: The Production Function and the Production Possibilities Frontier



3) Graphical Properties of PPF

- In Y, N space, MP_N was positive (Chapter_4). In Y, L space, MP_N is negative.
- Points on AB segment are not feasible because consumption is negative. Points on DB and below (the shaded area) are feasible.
- Slope of the PPF is MP_N. It is also known as **Marginal rate of transformation (MRT)**. MRT shows the rate at which L goods are transformed in to C goods through work. Then

  $MRT_{L,C} = MP_N = -$(slope of PPF)

  Remember the slope of PPF is already negative. So, $MRT_{L,C}$, MP_N are both positive.

Muhammad Rahman
Indiana University
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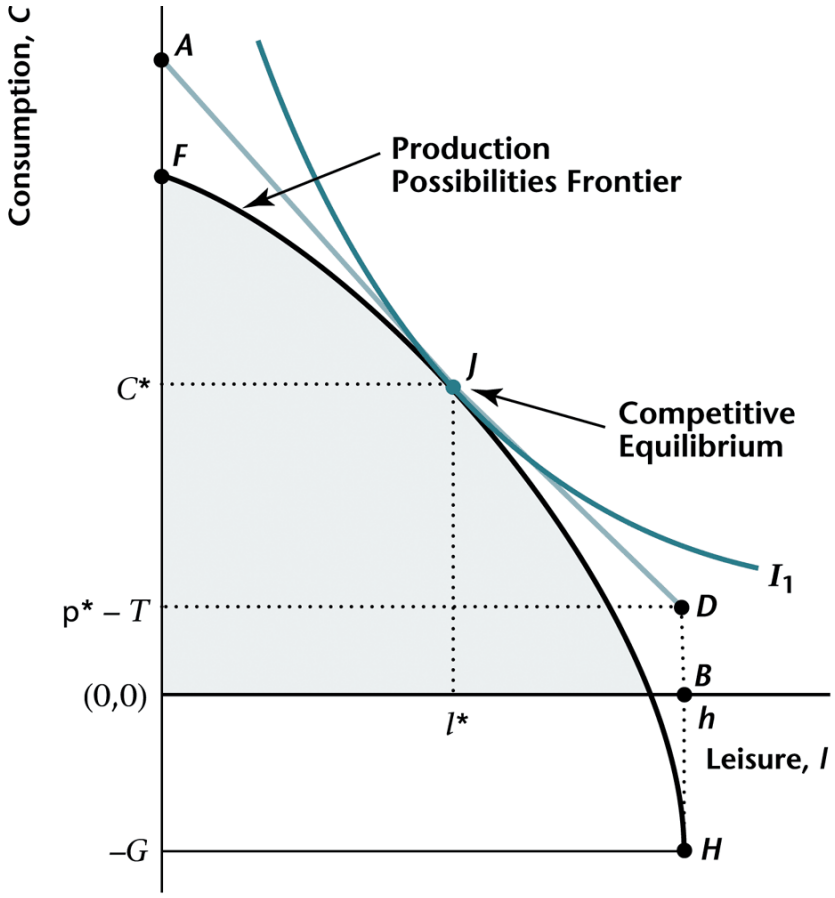
4) Integrating Consumer's behavior in Competitive Equilibrium

To integrate the consumer's behavior with firm's behavior to derive the CE, we draw the Indifference curves of the consumer on top of the PPF in the same C, L plane.

Figure 5.3 Competitive Equilibrium



5) Graphical Analysis of Competitive Equilibrium

- The IC is tangent to the PPF at point J. This is the CE of the economy.
- Point J determines equilibrium value of C which is C* and L*. Since J is also on the PPF, this means that firms' equilibrium hiring of labor is equal to = h - L*
- Point J is also on the IC. Slope of the IC at point is MRS_{LC}.
- The slope of the PPF at point J, $MRT_{LC}=MP_N$ = w for profit maximizing firms. Thus at point J, slope of the IC, MRSLC= w which is also the utility maximizing condition for the consumer.
- So, at point J both consumer and producer are behaving competitively. Hence Point J is the **CE** of the economy which is summarized by the following condition, $\mathbf{MRS_{LC} = MRT_{LC}=MP_N}$

E. OPTIMALITY OF CE

1) Motivation

We have identified that in competitive equilibrium the behavior of the consumer and the producer are consistent with each other. But it is not clear whether this consistent behavior is the optimal behavior of the agents of the model. So, we will introduce the concept of **Pareto Optimality** which will be an **Acid-Test** for whether CE is Optimal for the economy or not.

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2) Definition of Pareto Optimality(PO)

A CE is Pareto optimal is there is not way to rearrange production or reallocate goods so that someone is made better off without making some one else worse off.

- PO only focuses on the utility gain or the welfare of the consumer.

3) Formal of way of finding the PO allocation

In order to find PO allocation, we first have to define a **social planner**. He has the following characteristics:

- The social planner wants to maximize the social welfare or he wants to maximize the gain of the consumer and the producer.
- He is neither a consumer not a producer.
- He does not deal with the market.
- He can make consumers consume any combination C and L, force them to supply any about labor for the producer.
- He can force the producer to produce any level of good.
- He will take the production of Y, give portion to the government and allocate the remaining output to the consumer. Therefore, he will satisfy the income-expenditure identity (he is not completely irrational).

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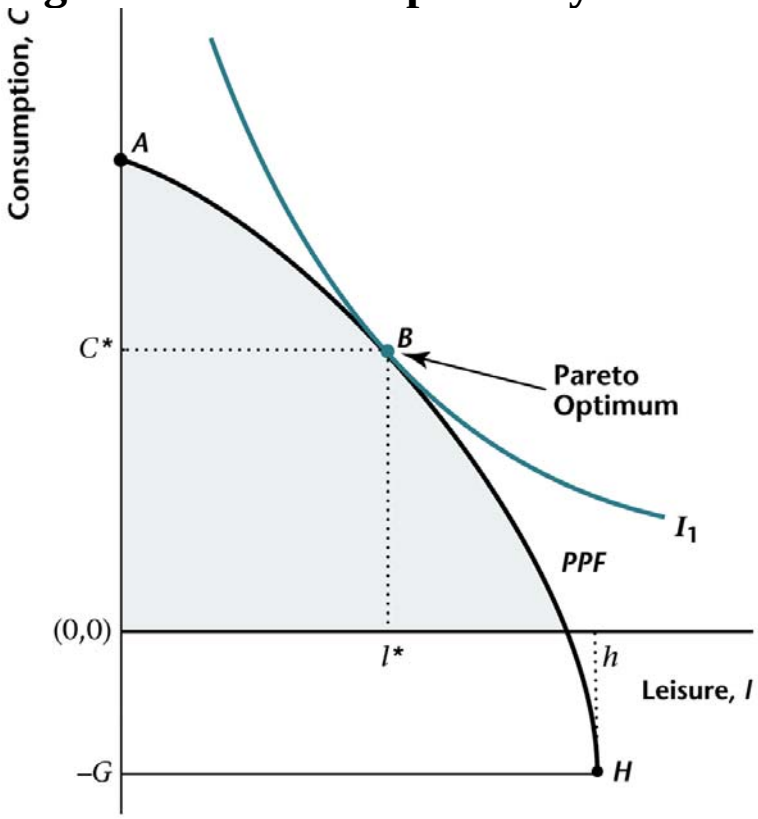
4) Graphical analysis of Pareto Optimality

- In this model there is only one consumer. So, we do not have worry about the issue of allocation of goods across people.
- We will focus only on possible reallocation of production to make consumer better off. If we can find some other reallocation of production that makes the consumer better off than the CE allocation, then CE is not PO. Otherwise it is.

Figure 5.4 Pareto Optimality



- As it turns out the tangency between the highest possible IC and the PPF will determine the PO allocation. This is quite intuitive because at this level the consumer is maximizing his utility and the producer is maximizing his profit.
- Thus PO implies:

  $\mathbf{MRS_{LC} = MRT_{LC} = MP_N}$

Critical Thinking

In Micro Economics, PO is defined as the output level where MSC = MPC and MPB = MSB. Since there is only one producer and one consumer, this condition is automatically satisfied.

F. IS CE ALWAYS PO? IS PO ALWAYS CE

This will be true under certain conditions. This will give two theorems:

1) **First welfare theorem(FWT)**
   The first welfare theorem states that under certain conditions CE is PO.
2) **Second Welfare theorem(SWT)**
   The second welfare theorem states that under certain conditions, PO is also CE

Critical Issue

1) The relation between CE and PO was first analyzed by Adam Smith in 1776 in his famous book "Wealth of Nations". He commented on the "Invisible Hand" which refers to a "Social planner" who could achieve both CE and PO allocation simultaneously. Alternatively it can be the "Market Force".
2) Conceptually, the line between the first welfare theorem and the second welfare theorem is very thin.
   a. When we are trying to analyze the FWT, we first determine a CE. Then we ask "**Is this allocation making everyone happy, or this there no other way to make anyone better-off without making anyone else worse-off?"** If the answer is yes, then we have found PO allocation and the FWT is proved.
   b. When we are trying to analyze SWT, we first determine a PO allocation and ask**" Is this allocation the market equilibrium allocation?"** if the answer is yeas, then we have found CE allocation and the SWT is proved.

Muhammad Rahman
Indiana University
Bloomington

G. IMPLICATIONS OF WELFARE THEOREMS

1) Implication of First Welfare Theorem

- Through individual private action (in the absence of distortions) the market result will be socially efficient.
- Positive statement - does not speak to distribution
- For example: one person is endowed with all resources and someone else nothing it is Pareto-Optimal outcome.

2) Implication of First Welfare Theorem

- Separate distribution and efficiency
- Prices play two roles in market system:
  - i) Allocate (scarcity)
  - ii) Distributive (purchasing power)
- To achieve Pareto-Optimal allocations one can redistribute endowment of agents (lump-sum taxation)
- Redistribution of endowment does not affect prices as these affect choices (Price change creates distortion and inefficiency).

Critical Issue: Adam Smith Again

1) SWT and FWT were again first observed by Adam smith. He argued:
- Unfettered economy of self-interested consumers and firms could achieve an allocation of resources and goods that was social efficient.

2) Pareto Optimality and C.E are only about efficiency (positive). They do not care about equity (normative).

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Indiana University
Bloomington

H. GRAPHICAL ANALYSIS OF THE WELFARE THEOREMS

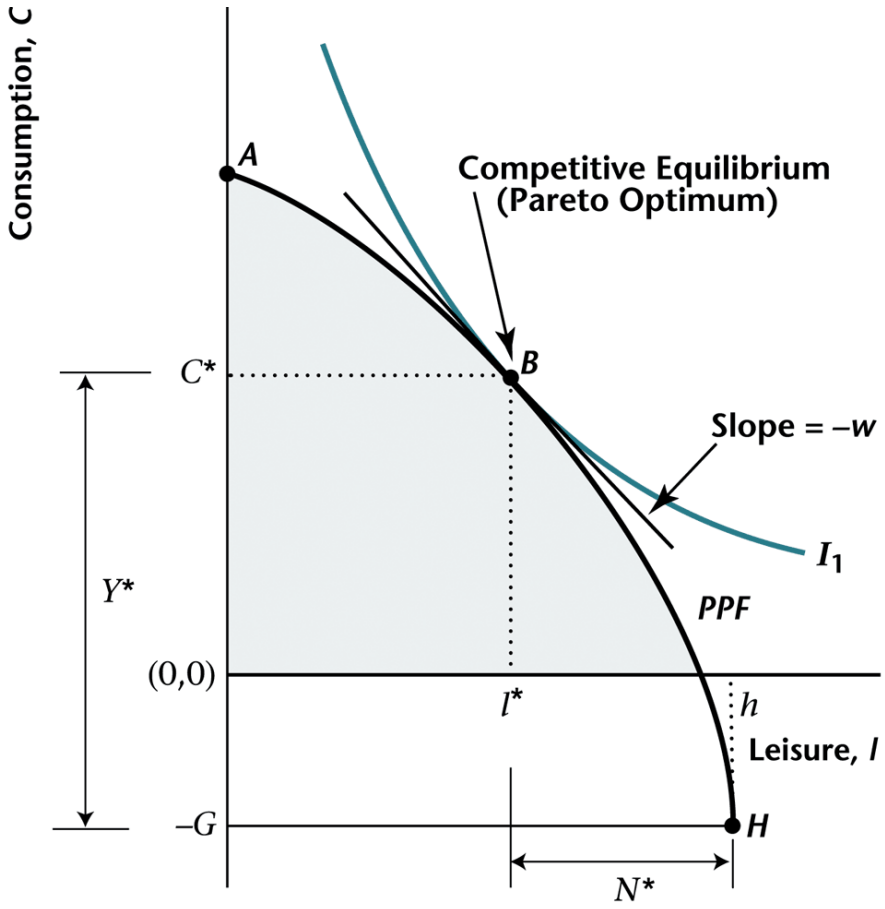
1) Analysis of first welfare theorem:

This relationship is very easy to verify. Without distortions, the economy would be at equilibrium at point B of figure 5.4 which also guarantees Pareto optimality. **Thus CE leads to PO**

2) Analysis of Second welfare theorem:

- The analysis of going from PO to CE is very tricky

Figure 5.5 Using the Second Welfare Theorem to Determine a Competitive Equilibrium



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Indiana University
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- Graphically, we will start from any point other than point B. we will see whether that point achieves PO allocation or not. This is done by considering a hypothetical reallocation to another point and analyze whether the welfare of any of the agent has increase or decreased or not.
- Following this strategy, we see point B maximizes the welfare of both the agents of the model. If we move to any other point either the utility of the consumer changes or the profit of the producer changes. Thus point B achieves PO allocation.
- Now we see that point B is also the point where the market is in equilibrium in the sense that consumer and the producer are optimizing their own objectives and the following condition is satisfied:

  $\mathbf{MRS_{LC} = MRT_{LC}=MP_N}$

  Sincere this sis the condition for CE, CE is also reached at point B. hence SWT is proved.

I. SOCIAL INEFFICIENCY AND FAILIURE OF WELFARE THEROEMS

1) Motivation

When ever we have social inefficiencies, CE may not lead to PO allocation and vice versa. Then the SWT and the FWT fails**.**

2) Sources of Social Inefficiencies

There are some important sources of social inefficiencies that prevents CE to be PO or vice versa. They are as follows**:**

Muhammad Rahman
Indiana University
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- **Externality:** Externality refers to a situation where the action of one agent may have an **unintentional** effect on the actions of some other agent of the model. This effect can be positive (bee industry having positive effect on the flower industry) or negative effect (industry pollutants effecting the fishing industry). In both case MPB $\neq$ MSB and MSB $\neq$ MPB. Hence we do not have PO allocations.
- **Distortionary Taxes**: A distortionary tax is a tax that effects the action of the consumers and the producers.
    a. A lump sump tax is a tax that does not effects the actions of the agents. An example of lump sump tax is the T in our example. **Without** lump sump tax, the wage income of the consumer is w (h-L). **With** lump sump tax, the wage income of the consumer is also w (h-L). Hence the tax does not distort consumer's decision about working. Also, the **effective wage** to the consumer is w. Again, the **effective wage** to the producer is also w.

        So, the consumer optimizes by setting,

        $MRS_{LC} = w$

        So, producer optimizes by setting,

        $MP_N = w$.

        Hence we have CE, where we have,

        $\mathbf{MRS_{LC} = MRT_{LC} = MP_N = w}$

        This is also the PO allocation.

b. An example of a distortionary tax is proportional income tax. Suppose there is a proportional tax t on the wage income of the consumer. **Without** wage income tax, the wage income of the consumer is w (h-L). **With** wage income tax, the after tax wage income of the consumer is w (1-t)*(h-L). Thus the presence of the income tax creates a distortion of the labor decision of the consumer (he works more with income tax than without tax).

c. **With** an income tax, the **effective wage** to the consumer is w (1-t). But the **effective wage** that the producer pays is still w (he does not pay any tax).
Therefore, the consumer optimizes by setting, $MRS_{LC} = w\ (1-t)$
Also, the producer optimizes by setting, $MP_N = w$.
So, **at the original** CE, we get the condition,
$MRS_{LC} < MP_N = MRT_{LC}$
This does not ensure PO allocation.

- **Non-Competitive behavior:** If the firms are not price taker, if they have some monopoly power over the market, then also we have inefficiency which **does not** lead to PO allocation. Similar inefficiency can occur if the consumers are not price takers.

Critical Issue

Q: How can consumers be **not price takers**?

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Indiana University
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J. POLICY EXPERIMENT

1) Objective

We would like to change the value of the exogenous variables of the model. We want to see how these changes affect our endogenous variables.

2) Effect of a change in Government Purchase(G)

- We will consider an increase in G from G_1 to G_2.
- G=T. An increase in G also increases T. This reduces the income of the consumer. The budget constraint of the consumer was: $\mathbf{C = wN^S + \pi - T}$

  $\therefore G \uparrow = T \uparrow \rightarrow Income \downarrow$
- A decline since both C and L are Normal **goods,** a decline in income cause both the consumption C and L to go down. So, for **consumers,**

  $\Delta G \uparrow \rightarrow (C, L) \downarrow \rightarrow N^S \uparrow \rightarrow N \uparrow \rightarrow$ **Eq'm Real wage rate** $\downarrow$
- For Producers there are two effects:

  $N^S \uparrow \rightarrow N \uparrow \rightarrow Y(K, N) \uparrow \rightarrow \Delta Y \uparrow \rightarrow \Delta Y \succ 0$

  Also, $N \uparrow \rightarrow$ They can and will hire more workers

  $\rightarrow$ $\mathbf{MP_N} \downarrow$ (Law of DMR) $\rightarrow$ **Eq'm Real wage rate** $\downarrow$

  So, in new equilibrium, real wage goes down which is consistent with optimizing behavior from the consumer and the producer.
- Again, if the producers produce more output with a lower wage, **probably** the profit of the producer goes up. This increases the dividend income of the consumer. For this there might also be an increase in the C and L.

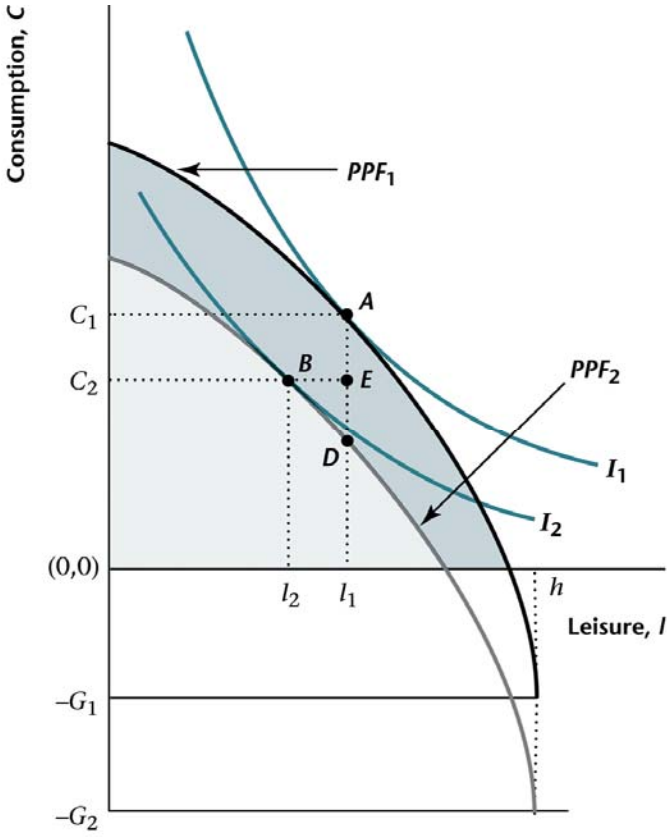
Very Very Important Critical Issue

An increase in the G causes both a decline in the income of the consumer (through T) and an increase in income (through π). As a result, C and L do not go down as much as they should if there was only pure income effect (only the effect of T)

- Now we **assume**, $\Delta Y \uparrow, \Delta G \uparrow, \Delta G \uparrow \succ \Delta Y$
  From Income-Expenditure identity, we know,
  C = Y-G
  Hence, $\Delta C = \Delta Y - \Delta G \prec 0$
  Therefore, an increase in G leads to a decline in C. This is called **Crowding out.**

Final Outcome of an increase in G
C↓, L↓, N↑, w↓

Figure 5.6 Equilibrium Effects of an Increase in Government Spending



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Indiana University
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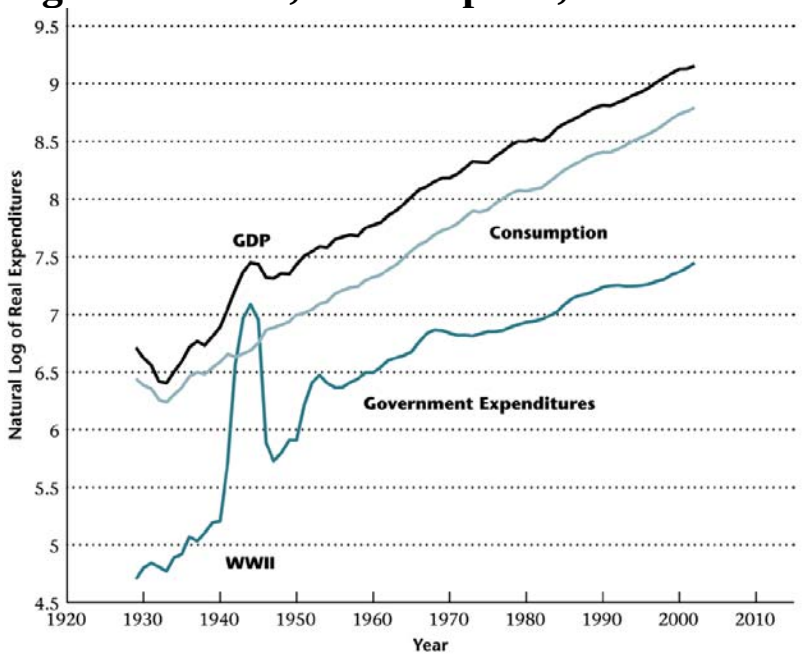
- Graphically, an increase in G causes a **downward Pivoted-shift of the PPF** (Both slope and intercept changes)**.** This is because there was crowding out. Hence the PPF should not shift down to the full amount of G. The new equilibrium will occur at a point on the PPF where the slope of the PPF is flatter than the original PPF to indicate that in the equilibrium, the real wage rate is lower than the original equilibrium wage rate.

Critical Thinking

Q: In the above example, we have seen that a change in government spending causes a change in the production of the economy. So, a change in G affects GDP. That means changes in G can cause Business Cycle. **Does it really happen?**

Answer: It does. Look at USA data. During the WWII, an increase in G caused an **increase** in GDP(Y) and a slight **decline** in C which is consistent with our model

Figure 5.7 GDP, Consumption, and Government Expenditures



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Indiana University
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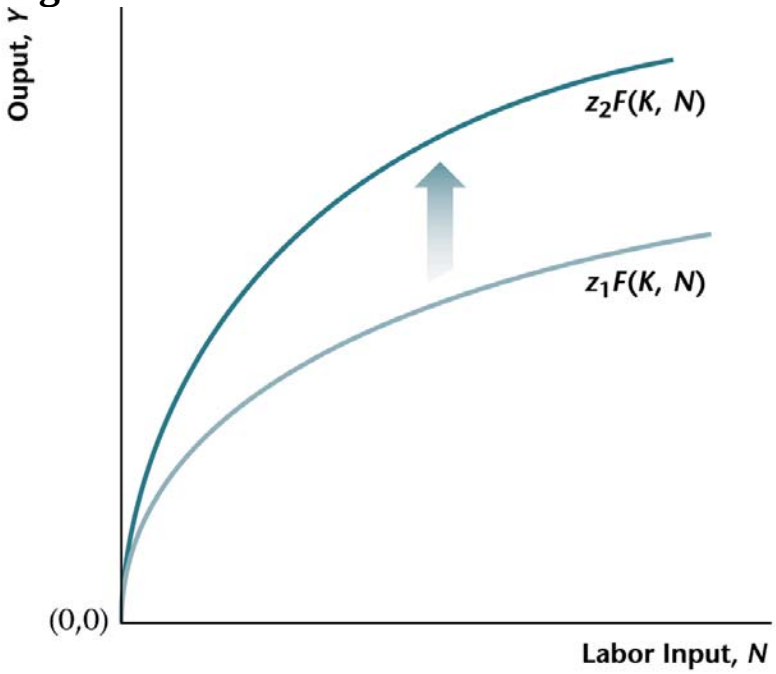
3) Effect of an Increase in Total Factor Productivity(z)

We will analyze the effect of total factor Productivity on different variables separately:

3. a) Effect on Output

An increase in z is an improvement in technology. This will **surely** increase output(Y) with a given amount of input. An increase in z therefore causes an upward shift of the Production Function.

Figure 5.8 Increases in Total Factor Productivity



3. b) Effect on CE

An increase in z, similar to PF will cause an upward shift of the PPF (more C can now be produced with same N^s or L). Also an increase in z will increase the MP_N. Thus the slope of the shifted PPF will be different at every point compared to the original PPF. This will affect the CE in a very interesting way. We will analyze the effect of z on the equilibrium values of three variables:

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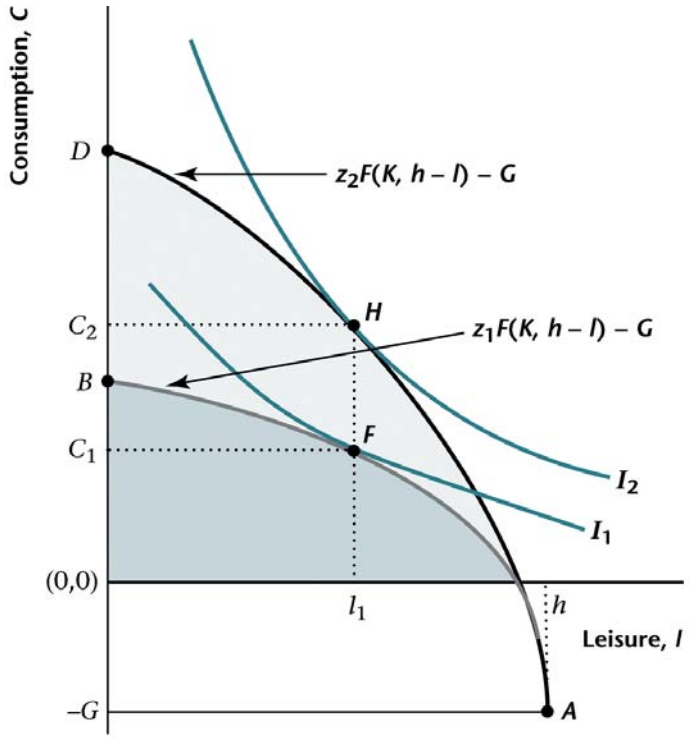
Figure 5.9 Competitive Equilibrium Effects of an Increase in Total Factor Productivity



- **Real wage:** Since z increase MP_N, at the new equilibrium, the real wage would go up.
- **Consumption:** An increase in z will increase the income of the consumer. This income effect will cause C to go up. Also at the new equilibrium, the increase in real wage will cause a SE which will also help consumer to buy more C(C is now the cheaper good). These two effects will cause C to go up **surely.**
  In the above graph, the increase in z has caused PPF to shift up from AB to AD. The new equilibrium is at point H. Compared to the old equilibrium F, consumption has gone up.

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Indiana University
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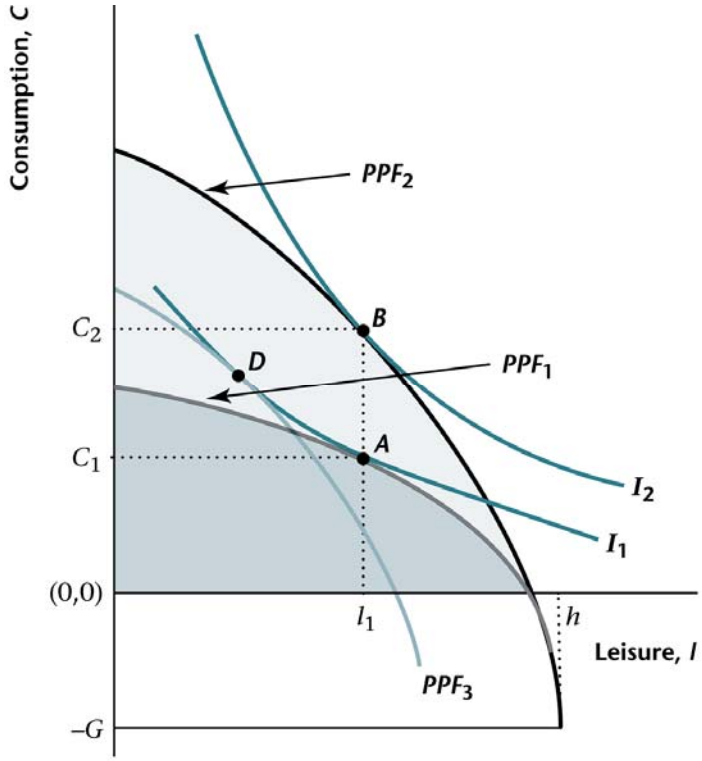
- **Leisure (L) or Labor (N):** because of the income effect, consumer wants to buy more leisure (which will decrease N). But because of SE consumer wants to buy less of leisure (which will increase N). Therefore, the effect of z on the equilibrium value of L or N is ambiguous. We will three cases:

Figure 5.10 Income and Substitution Effects of an Increase in Total Factor Productivity



In the graph above, we have decomposed the effect of an increase in z into SE (movement from A to D) and IE (movement from D to B). We see three kinds of cases:

1) If SE > IE, L goes down, N goes up
2) If SE < IE, L goes up, N goes down.
3) If SE = IE, L remains unchanged between the new and the original equilibrium (which is the case in figure 5.10), N also remains unchanged.