ECON 310 - MACROECONOMIC THEORY

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Chapter 5: Closed Economy Model

1. Put together a macro model
2. Close economy
3. General equilibrium

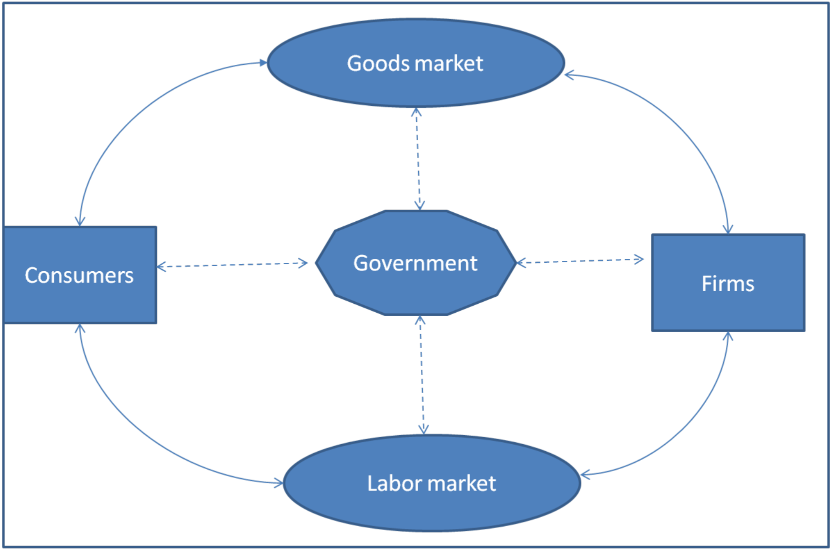
Topics

- Introduce the government.
- Construct closed-economy one-period macroeconomic model.
- Economic efficiency and Pareto optimality.
- Experiments:
    - Increases in government spending and total factor productivity.
    - Consider a distorting tax on wage income and study the Laffer curve

Government

- Govt provides public goods purchase (G)
- Finance via lump-sum tax (T)
- Govt budget constraint
- No borrow or lending 1-period
- so, $G = T$
- Govt is exogenous i.e. Exog - Model - Endo

An Overview of a Simple Economy Model

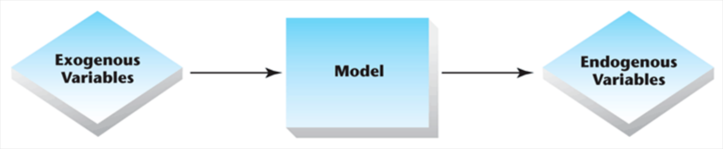


Key Features of the Model

- Closed economy (no interaction with rest of world)
- Three players:
- Consumers: sell labor and buy goods
- Firm: buy labor and sell goods
- Government: exogenous
- 2 markets:
- goods and labor markets
- Relative prices as signals
- Competitive equilibrium concept

Model

Figure 1: A Model Takes Exogenous Variables and Determines Endogenous Variables



- Exogenous variables: determined outside the model
- z, K, and G
- endogenous variables: determined within the model
- **Households:** demand for C and I (i.e. supply of N^s)
- **Firms:** demand for labor N^d and generating profits π
- **Government:** tax consumers with lump-sum tax T
- **Market equilibrium:** demand = supply will determine price, i.e. the wage rate w

Competitive Equilibrium

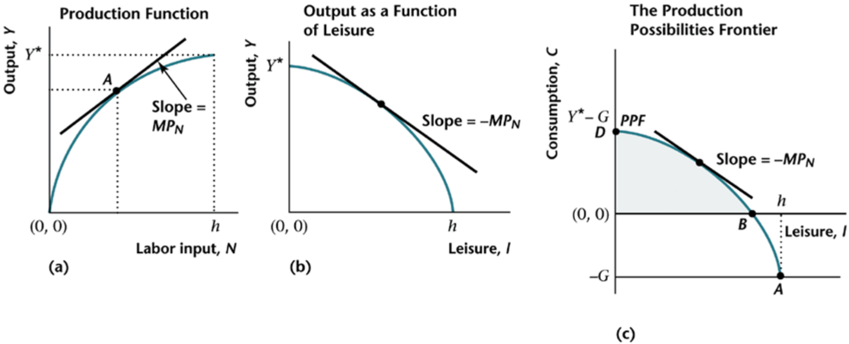
- Take exogenous: G, z, K
- Results in endogenous: C, N^s, N^d, T, Y, w
- Do policy experiments with G, z, K see how it affects BLAH
- Model must be consistent (jive):
- Look at competitive eqm: firms and consumers price-takers
- Actions of firms and consumers are consistent
- Price w clears market $N^s = N^d$
- Two markets Goods and Labor (Walras Law) focus on Labor

Competitive Equilibrium

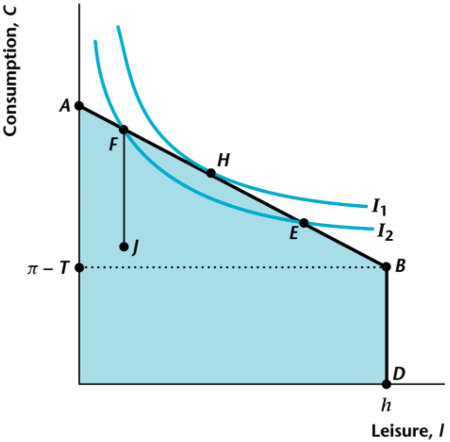
- A **Competitive Equilibrium** is defined as:
  - a set of quantities: C, N^s, N^d, T, Y,
  - a set of relative prices, w (real wage, i.e. relative price of labor to consumption)
  - such that given G, z, and K the following conditions satisfied:
- **Consumers Maximize Utility:** Given relative prices, w, consumer's choices of C and l maximize its utility subject to its budget constraint.
- **Firms Maximize Profits**: Given relative prices, w, firms choices of Y and N maximize its profits.
- **Markets Clear**:
  - Goods market clears, i.e. $C + G = Y$ (where G is exogenous government spending).
  - Labor market clears, i.e. $N^d = N^s = h - l$
- GBC is satisfied $G = T$, taxes paid is equal to government spending

Constructing PPF

Figure 2: Production Possibility Frontier (PPF)



Recall: Optimal Consumption-Leisure Choice



Competitive Equilibrium

- In Y, N space MPN is positive
- In Y, l space MPN is negative and C, l is affine shift (G) down
- Note under AB not feasible since $C < 0$
- MRT is slope of PPF

$$MRT_{l,C} = MPN = -(\text{slope of PPF})$$

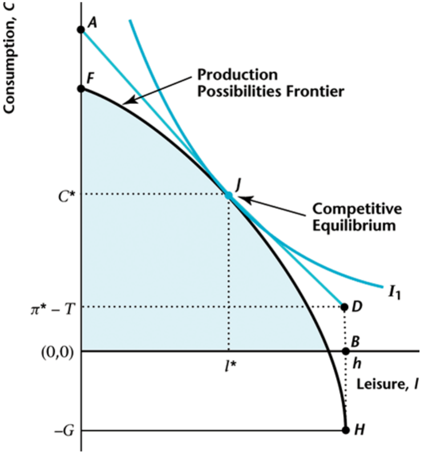
- In equilibrium

$$MRT = w = MRS$$

- At Point J is C.E. because

$$MRS_{l,C} = w = MPN = MRT_{l,C}$$

Figure 3: Competitive Equilibrium



Pareto Optimality

- C.E. and economic efficiency
- Markets can produce social optimal outcomes
- Easier to work w/ social optimum rather C.E.
- Efficiency (Pareto: Italian economist)

Pareto Optimality

A C.E. is Pareto Optimal if there is no way to rearrange production or to reallocate goods so that someone is made better off without making someone else worse off.

- Is the C.E. a Pareto Optimal?
- Introduce **Social Planner**: benevolent dictator (cares about everyone)

Pareto Optimality (cont.)

- Tells agents what to consume/produce subject to constraints

$$MRS_{l,C} = MRT_{l,C} = MPN$$

- In this case the C.E. = Pareto Optimal

1st Fundamental Theorem of Welfare Economics

Under certain conditions, C.E. is Pareto Optimal.

2nd Fundamental Theorem of Welfare Economics

Under certain conditions, Pareto Optimal is a C.E.

Social Planner Problem

- The planner problem is

$$\begin{aligned} &max \text{ Preferences} \\ &s.t. \\ &\quad \text{Technology} \end{aligned}$$

- There are no markets and not prices in the planner problem
- More formal

$$\max_{c,l} u(c,l)$$

$$s.t.$$

$$C = zF(K, h - l) - G$$

Social Planner Problem (cont.)

- We can rewrite this as and substitute consumption using the budget constraint into preferences

$$\max_{l} u\left(\overbrace{\underbrace{zF\left(K, h-l\right)}_{Y} - G}^{C},\ l\right)$$

- Derive w.r.t. l results in the first order condition (or optimality condition of the social planner)

$$\frac{\partial u\left(C, l\right)}{\partial C} \times \frac{\partial Y\left(K, l\right)}{\partial l} \times (-1) + \frac{\partial u\left(C, l\right)}{\partial l} = 0.$$

- Simplifying this we can write

$$\begin{aligned} -u_C \times MPN + u_l &= 0, \\ \rightarrow MPN &= \frac{u_l}{u_C}. \end{aligned}$$

Social Planner Problem (cont.)

- We now know from earlier discussion that $MPN \equiv MRT$ and we know that $MRS \equiv \frac{u_l}{u_C}$ so that the optimality condition for the planner is

$$MRT = MRS.$$

- Note that there are no prices (w), no markets, there is no household budget constraint that a household needs to abide by and there is no firm profit maximization problem either. The planner simply uses the production technology and assigns quantities directly so that household utility is maximized.

Competitive Equilibrium: Decentralized Household/Firm Problems

- The household problem is

$$\mathit{max}\ \text{Preferences}$$
$$\mathit{s.t.}$$
$$\text{Budget Contraint}$$

  and the firm problem is

$$\max\ \text{Profits.}$$

- There are markets for factors of production (labor) and for the final consumption good.

Competitive Equilibrium: Decentralized Household/Firm Problems (cont.)

- More formal households maximize

$$\max_{c,l} u\left(c, l\right)$$

$$s.t.$$

$$C = \left(h - l\right) w + \pi - T$$

and firms maximize (capital is given because it's a one period model without saving):

$$\max_{N^d} \overbrace{z \times F\left(K, N^d\right)}^{Y} - w \times N^d$$

Competitive Equilibrium: Decentralized Household/Firm Problems (cont.)

- We can rewrite the household problem and substitute consumption using the budget constraint into preferences

$$\max_{l} u\left(\overbrace{(h-l)\,w+\pi-T}^{C},\ l\right)$$

- Derive w.r.t. l results in the first order condition (or optimality condition of the household)

$$\frac{\partial u\,(C,l)}{\partial C}\times(-1)w+\frac{\partial u\,(C,l)}{\partial l}=0.$$

- Simplifying this we can write

$$-u_C \times w + u_l = 0,$$

$$\rightarrow w = \frac{u_l}{u_C}.$$

Competitive Equilibrium: Decentralized Household/Firm Problems (cont.)

- We now know from earlier discussion that $MRS \equiv \frac{u_l}{u_C}$ so that the optimality condition of the household is

$$MRS = \frac{w}{1}$$

which is the price ratio of the two "goods". Note that the price of consumption is normalized to 1 and the price of leisure is its opportunity cost w.

- The firm first order condition is

$$\frac{\partial Y\left(K, N^d\right)}{\partial N^d} - w = 0$$

or

$$MPN = w.$$

Competitive Equilibrium: Decentralized Household/Firm Problems (cont.)

- Note that prices w connect the household and firm side. Since in equilibrium both the household and firm first order conditions hold, we can combine them using prices w to get

$$MRS = \frac{w}{1} = w = MPN \, (\equiv MRT)$$

  which equates $MRS = MRT$ just like in the planner problem.
- We have thus shown that the **competitive equilibrium** is Pareto efficient $\rightarrow$ **First Welfare Theorem.**
- The welfare theorems indicate that the solution you get as a **(centralized) planner can be the same solution** (under certain conditions like no market failures, no distortive taxes, etc.) than what you would get if you solved this as a (**decentralized**) **competitive equilibrium.**

Figure 4: Pareto Optimality

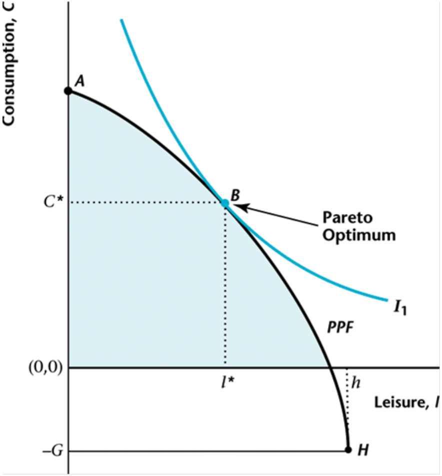


Figure 5: 2nd Welfare Theorem to determine C.E.

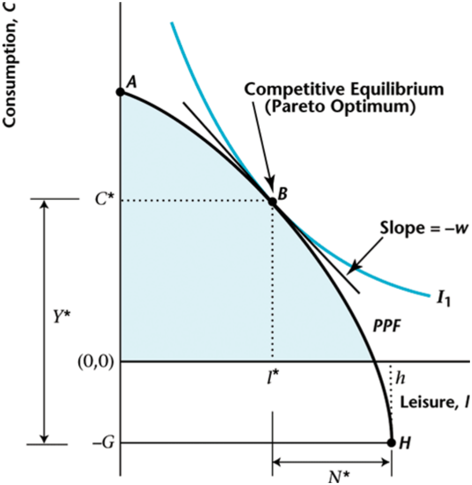
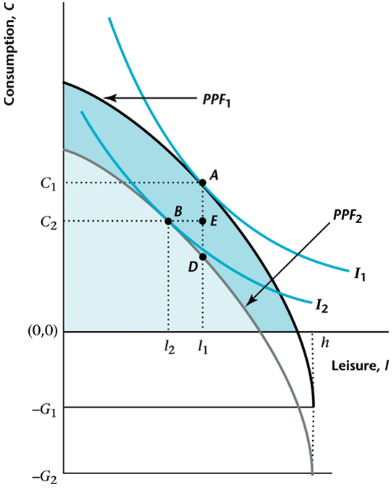


Figure 6: Increase in Government Spending



WWII is a natural experiment see small crowding out

Figure 7: GDP, Consumption, Government Expenditures

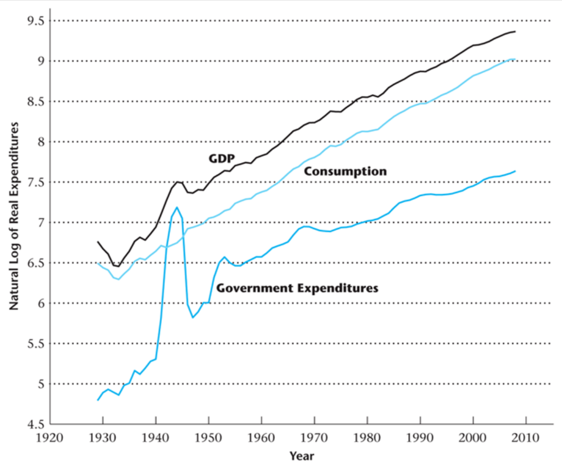


Figure 8: Government Expenditures as a Percentage of GDP

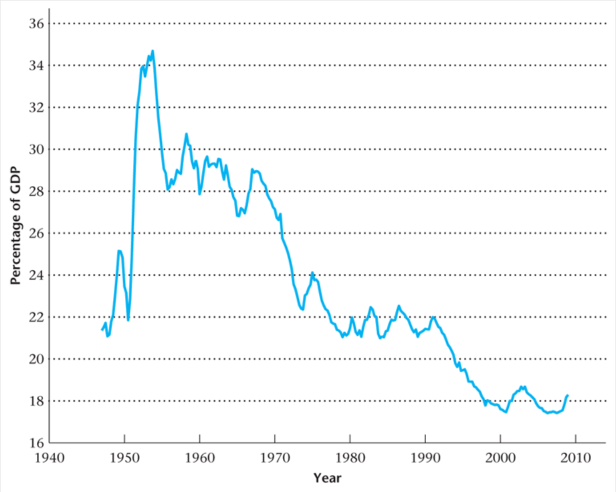
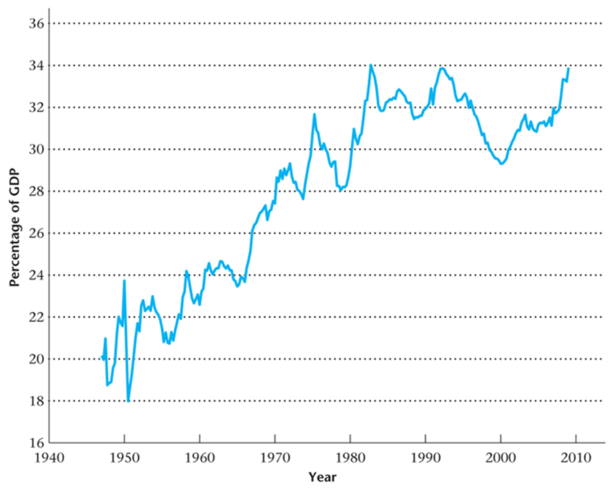


Figure 9: Total Government Outlays as a Percentage of GDP



Increase in Total Factor Productivity

Better technology, innovation, something related to productivity (exogenous)

Start at pt F w/ PPF A-B an $\uparrow$ in z or TFP results in

- $\uparrow$ wage - if SE=IE so that pt H is new eqm

Figure 10: Increase in Total Factor Productivity

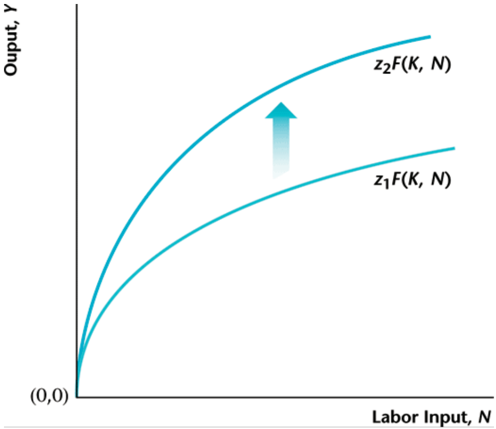
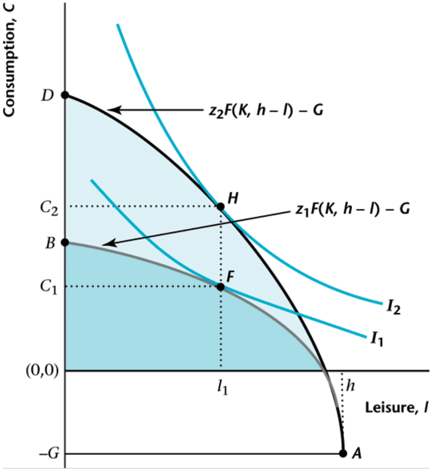


Figure 11: C.E. Effects of Increase in TFP



IE/SE of Increase in TFP

- Decompose SE and IE
- Effects on N ambiguous due to SE/IE effects
- Total welfare increase b/c of technology

Figure 12: IE/SE of Increase in TFP

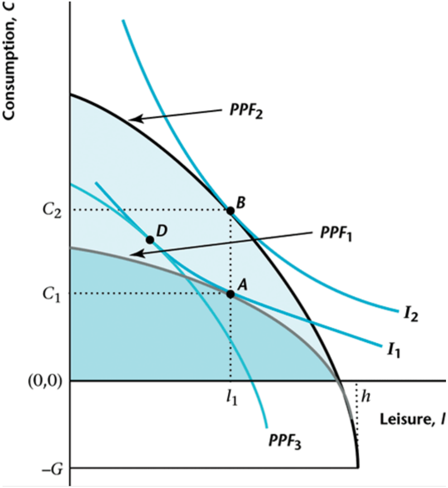


Figure 13: GDP vs. Solow Residual

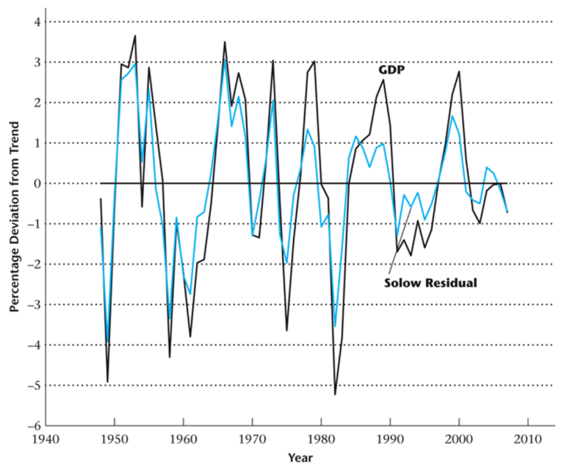
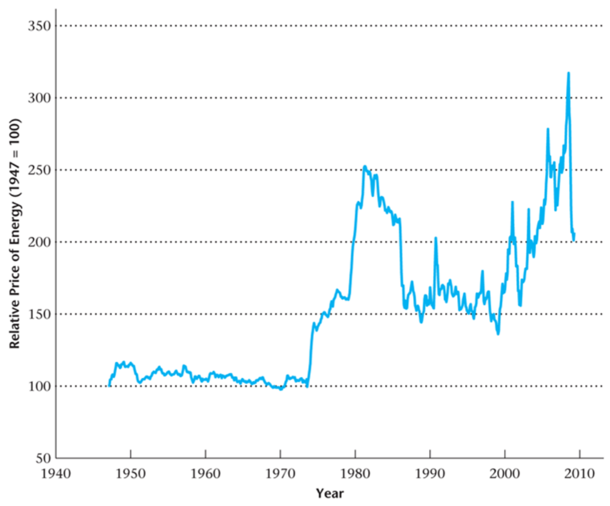


Figure 14: Relative Price of Energy



Model with Distortionary Taxes

- Assume linear production function in labor (no capital)

$$Y = zN^d$$

- C.E. implies $N^d = h - l$ and $C + G = Y$ so that PPF:

$$C = z(h - l) - G$$

- Notice the PPF in Fig 5.-8 is linear.
- Instead of lump-sum tax government imposes proportional tax $0 < t < 1$

$$C = w(1 - t)(h - l) + \pi$$

- $w(1 - t)$ is the effective wage rate

Model with Distortionary Taxes (cont.)

- Profit maximization of firm is:

$$\pi = Y - wN^d = (z - w)N^d$$

- Zero profits imply $z = w$, therefore N^d is ∞-elastic (Fig 5.9)
- Consumer budget constraint is:

$$C = z(1 - t)(h - l)$$

remember that Government expenditures equals tax revenues:

$$G = zt(h - l)$$

- Fig 5.15 the C.E. is H whilst Pareto Optimal is E .
- Tax is distortive and workers enjoy more leisure!

Figure 15: PPF in the Simplified Model

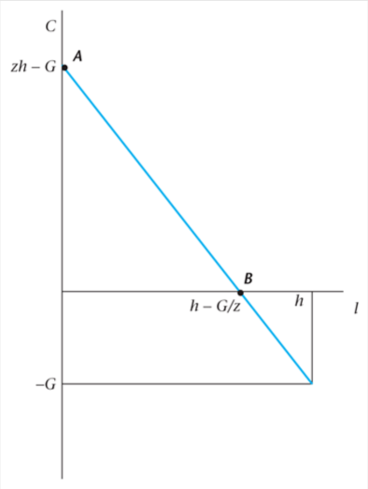


Figure 16: Labour Demand Curve in the Simplified Model

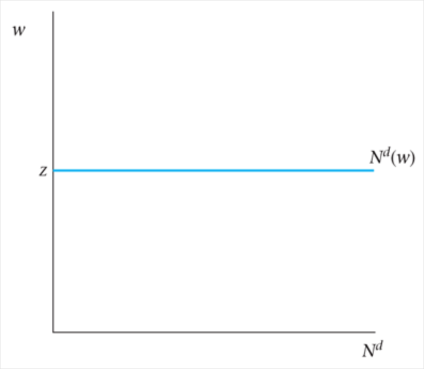
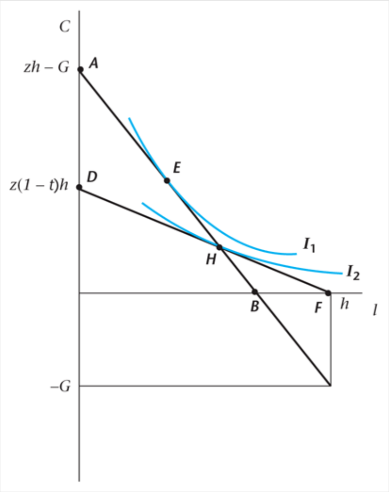


Figure 17: C.E. in the Simplified Model with a Distortionary Tax



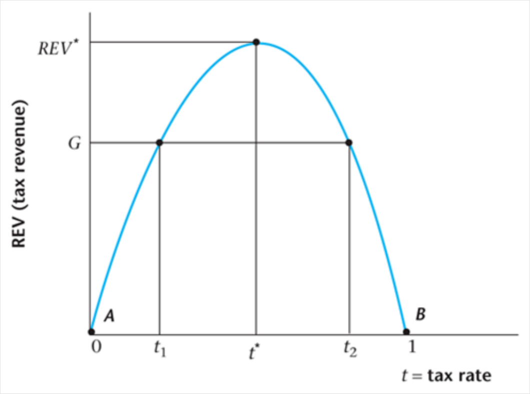
The Laffer Curve

- Hold z constant so that

$$Rev(t) = t[h - l(t)].$$

- Total revenue is a function of:
- Tax base, $[h - l(t)]$, is a function of t
- Tax rate, t
- Notice $t = 0$ or $t = 1$ no tax revenue is collected
- Increase in t not necessarily increase tax revenues
- If $SE > IE$ then at some point $[h - l(t)]$ will fall
- Example: $l(t) = \alpha t$, optimal tax rate $t^* = h/2\alpha$
- Laffer Curve see Fig 5.16

Figure 18: A Laffer Curve



Is the U.S. Economy on the Bad Side of the Laffer Curve?

- Reagan administration: cuts in marginal tax rates in 1981.
- Bush administration: cuts in marginal tax rates in 2001.
- Results: decrease in tax revenue in both cases.
- Implication: We are on the good side of the Laffer curve

Figure 19: Two C.E.

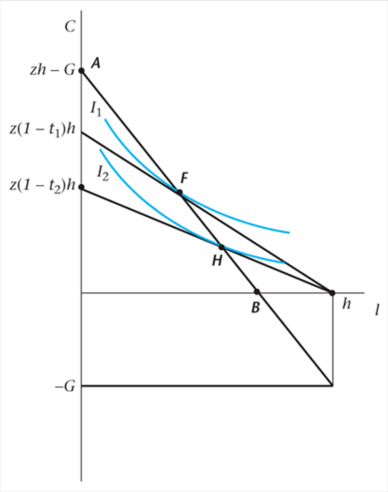


Figure 20: Federal Personal Taxes as a Percentage of GDP