

Diminishing Marginal Products

- Why are factors' marginal products decreasing?
- Consider for example, the use of capital in an office job
 - Without a computer, it is very difficult to perform many tasks.
 - Giving an office worker a computer has a large effect on that worker's output, so marginal product of capital initially high.
 - And while a more powerful computer may allow the worker to produce more, given the task performed by the worker, the extra computing power is unlikely to raise the worker's output proportionately: the marginal product of capital declines.
- This argument takes as fixed the number of workers, their skills, and state of technology.

Per-Worker Production Function (cont.)

- If the production function is neoclassical, the per-worker production function has an increasing and concave shape
- Output: $Y = zNf\left(\frac{K}{N}\right)$
- Marginal product of capital: $MP_K = \frac{\partial Y}{\partial K} = zf'\left(\frac{K}{N}\right) = zf'(k)$
- MP_K is positive but diminishing (in K and k)
- Implies $f'(k)$ is an increasing and concave function of k

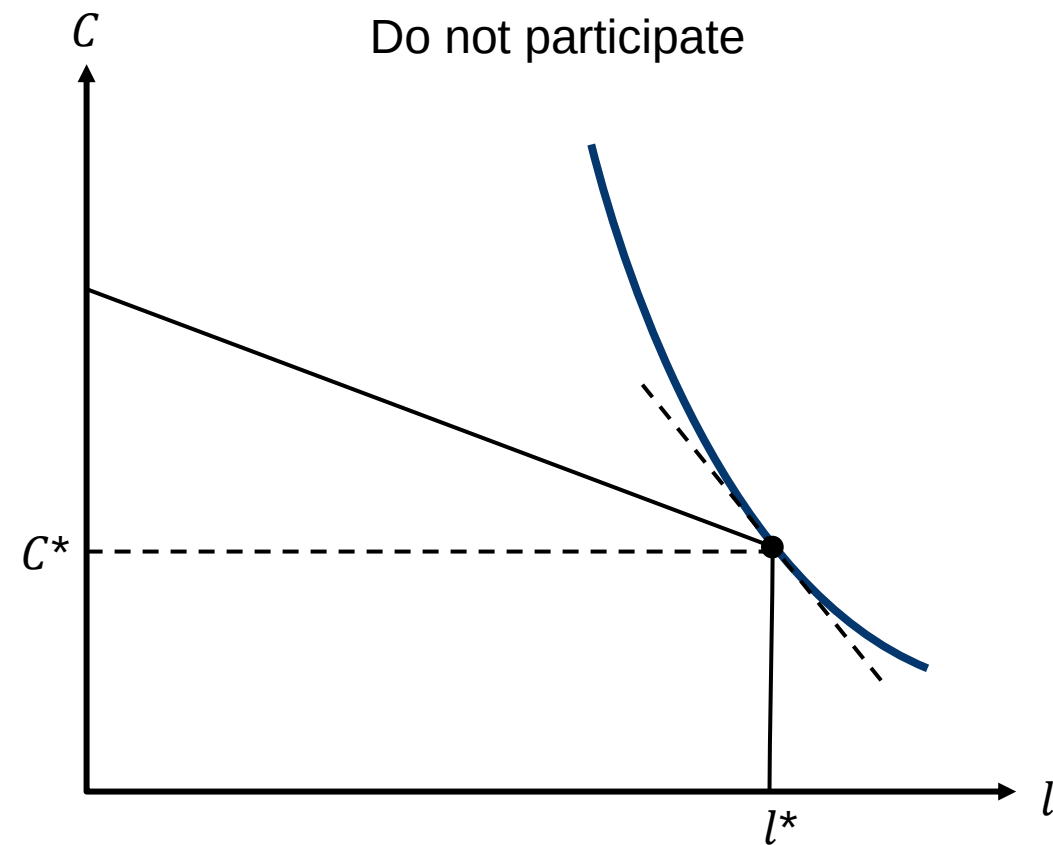
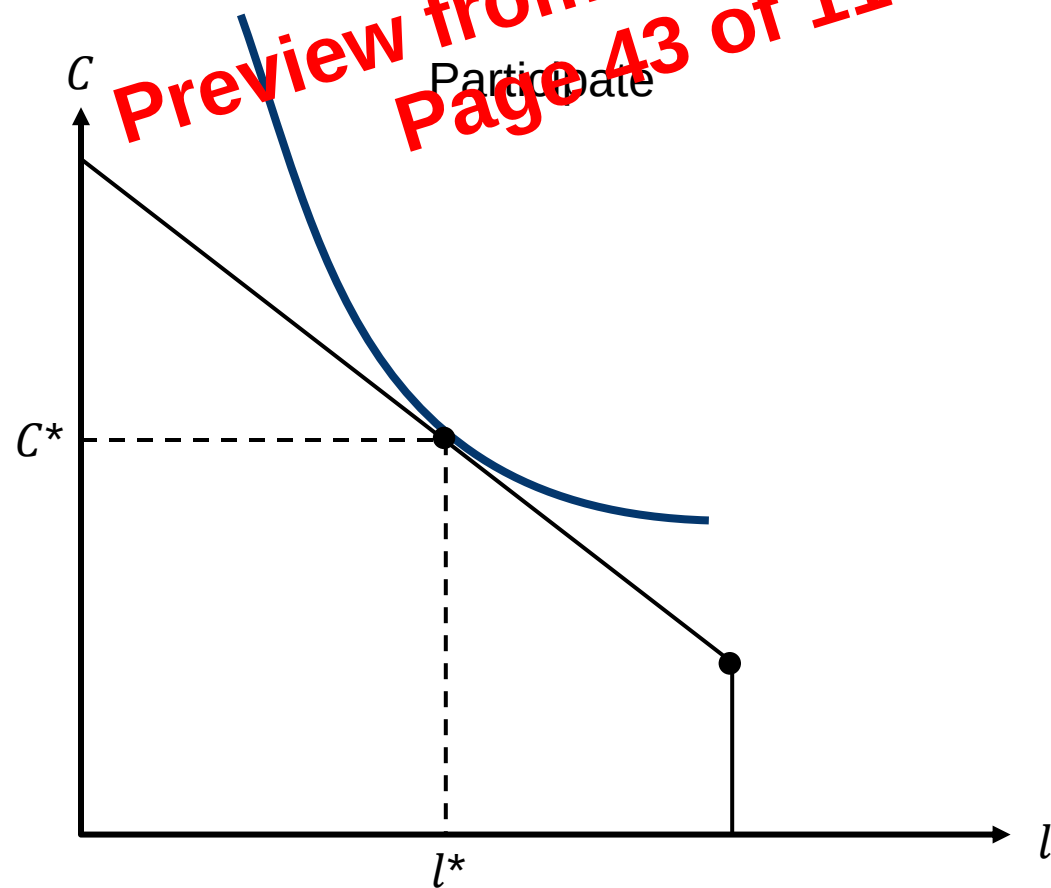
Determinants of Population Growth

- Malthus argued (1798) that per-capita income and consumption affect population growth.
 - Lower consumption per person leads to worse nutrition and health, hence higher death rate and infant mortality, and lower (or negative) population growth rate.
 - Lower income per person induces families to have fewer children they would struggle to support, hence lower birth rate, and lower population growth rate.
 - Higher income and consumption have the opposite effects and raise the population growth rate.
 - Effects are larger when people are close to subsistence.

Agricultural Economy

- Malthus's demographic assumption is particularly relevant for an agricultural economy
 - Land L and labour N are the key factors of production.
 - Land L is in fixed supply.
- Neoclassical production function: $Y = zF(L, N)$
- No capital, so no investment (and ignore government and international trade), hence average consumption per person c is equal to income per worker $y = Y/N$

Optimal Choice



The Effect of Wages on Participation (cont.)

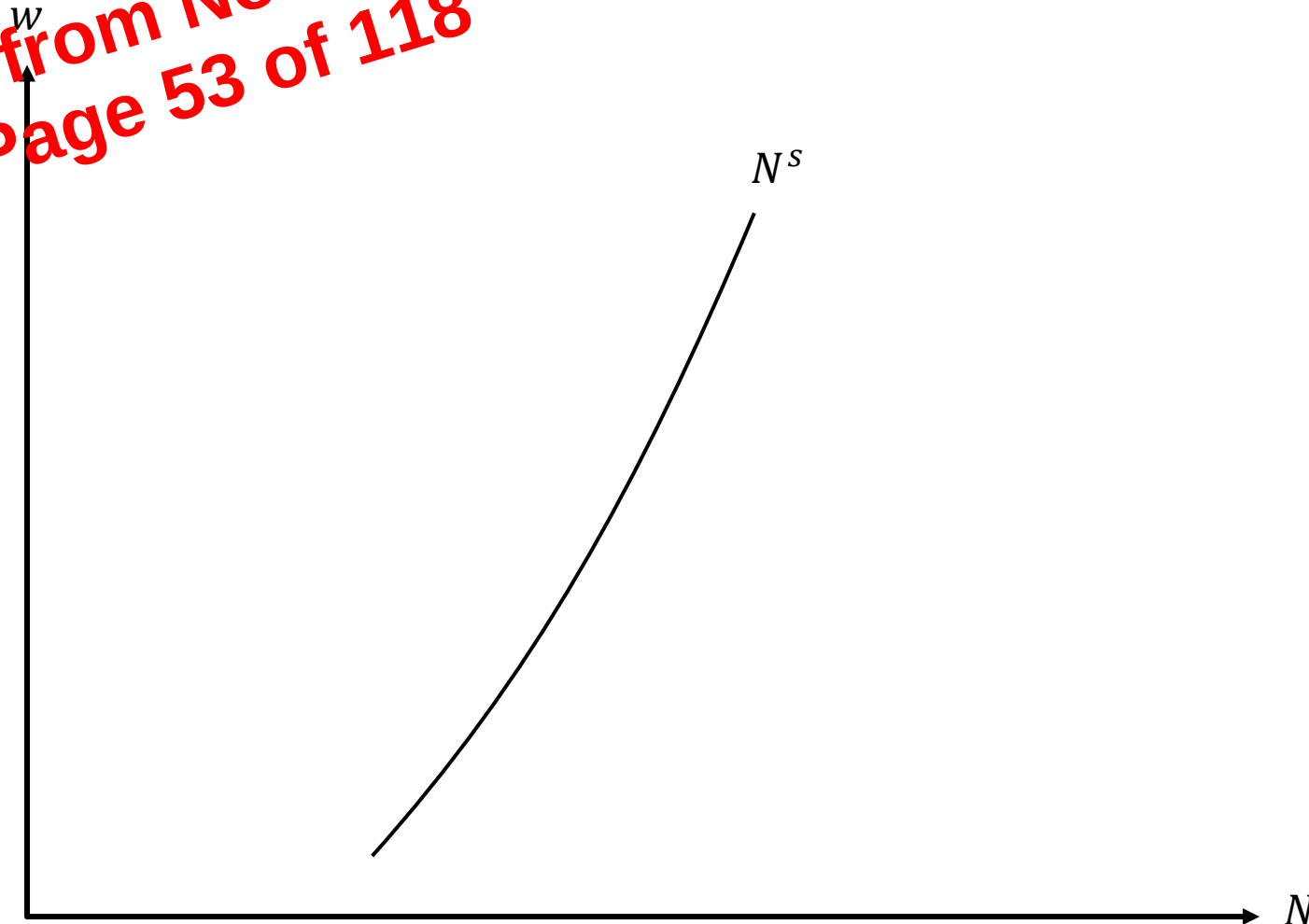
- Higher wage makes budget constraint steeper, pivoting it around the point of non-participation.
- Since indifference curve needs to be steeper than budget constraint for non-participation to be chosen, a sufficiently high wage triggers participation in the labour market.
 - No offsetting income effect on the participation decision because higher wage does not make non-participants better off
 - Unless some income comes from a partner who works, in which case higher wages have an income effect on the household labour supply.

Labour Supply Curve

- The labour supply curve shows the optimal choice of $N^S = l - l$ at each level of wages w .
 - For those participating in the labour market, hours worked increase if the substitution effect is larger than the income effect
 - For those not participating initially, no income effect until some labour is supplied
- N^S curve upward sloping if SE dominates IE.
 - If everyone participates, N^S given by equation $MRS_{l,c} = w$.

Labour Supply Curve (cont.)

Preview from Notesale.co.uk
Page 53 of 118



Equilibrium

- In the goods market:
 - Firms produce Y
 - Households and the government demand $C + G$
 - Equilibrium: $C + G = Y$
- In the labour market:
 - Firms demand N^d , determined by $w = MP_N$
 - Households supply N^s , determined by $w = MRS_{l,C}$
 - Equilibrium: $N^d = N^s$
- Budget constraints: $C = wN^s + \pi - T$, $\pi = Y - wN^d$, and $G = T$, combined: $w(N^d - N^s) = Y - (C + G)$

Understanding Inequality in Wages

- The last few decades have seen rising income inequality within many countries. Why?
 - Focus on inequality in wages rather than income inequality more broadly (including capital income) or wealth inequality.
- One important dimension of the rise in wage inequality is the increase in the relative wages of highly skilled workers compared to those with more basic skills.
 - Increase in “college wage premium” in the US and elsewhere.
 - Crucial to debate on the returns to higher education: returns might be higher even if the cost of education has risen.

Production Using Skilled and Unskilled Labour

- Separate the supply of labour into high-skilled workers H and unskilled workers N .
 - Supply of H related to concept of “human capital” studied later.
- Production function $Y = zF(K, N, H)$ is assumed to be:
$$Y = z(K^\alpha N^{1-\alpha} + BK^\alpha H^{1-\alpha})$$
 - α , between 0 and 1, is importance of capital relative to labour.
 - z = total factor productivity – affects all marginal products.
 - B = skill-biased technology – affects marginal product of H .
- Cobb-Douglas production function $Y = zK^\alpha H^\beta N^{1-\alpha-\beta}$ not used as cannot build in skill-biased technological change.

A 14th-Century Pandemic

- Around 1350, Europe, North Africa, and Western Asia, are struck by a bubonic plague pandemic (the “Black Death”).
- This pandemic is believed to have killed more than a third of the population of the affected areas.
- The main economic effect of the pandemic comes from the shortages of labour it creates.

Factor Payments and Relative Factor Supplies

- Per-worker production function implies $Y = zNf\left(\frac{L}{N}\right)$.
- Marginal products (using the chain rule):
 - Land: $MP_L = \frac{\partial Y}{\partial L} = z \frac{N}{N} f'\left(\frac{L}{N}\right) = zf'(l)$
 - Labour: $MP_N = \frac{\partial Y}{\partial N} = zf\left(\frac{L}{N}\right) - zN \frac{L}{N^2} f'\left(\frac{L}{N}\right) = z(f(l) - lf'(l))$
 - Implies $w = y - xl$, output per worker minus rent times land per worker.
- Depend on relative supply of land to labour $l = L/N$.
 - MP_L is diminishing in l because $f(l) = F(l, 1)$, so $f''(l) < 0$.
 - MP_N is increasing in l because derivative of $f(l) - lf'(l)$ with respect to l is $f'(l) - f'(l) - lf''(l) = -lf''(l) > 0$.

preview from Notesale.co.uk
page 78 of 118

Do Higher Tax Rates Raise More Revenue?

How to Pay for Public Expenditure?

- Suppose government needs to pay for public services G .
- Assume output produced using land L and labour N .
 - Land L is in fixed supply.
 - Labour N is labour supply of a representative household.
 - Production function: $Y = aN + bL$
 - Linear in both L and N (not neoclassical, but useful for illustration).
 - Marginal products are $MP_N = a$ and $MP_L = b$ (where a and b are positive constants).
 - Pre-tax wage w and rent x determined in competitive markets:
$$w = MP_N = a \quad , \quad x = MP_L = b$$

Switch from Taxes on Wages to Taxes on Rents

- Initially only wage income taxed: $a\tau_w N = G$ and $\tau_x = 0$
- Optimal choice of C and $l = h - N$ at tangency of budget constraint and indifference curve: $MRS_{l,C} = a(1 - \tau_w)$.
 - On budget constraint, so $C + a(1 - \tau_w)l = a(1 - \tau_w)h + bL$.
- Switch to tax on rents: $b\tau_x L = G$ and $\tau_w = 0$
 - Assuming $bL > G$, so enough rental income to tax.
- Budget constraint steeper; shifts down at $l = h$.
- Observe that same choice of C and l remains affordable:
 - Original C and l satisfy $C + al = ah + b(1 - \tau_x)L$.
 - Because $a\tau_w(h - l) = a\tau_w N = G = b\tau_x L$.

Production Function

- Focusing on capital and labour as the factors of production and ignoring land, the production function is:

$$Y = zF(K, N)$$

- Gross domestic product (GDP) is Y , the labour force is N (number of workers), the capital stock is K , and total factor production (TFP) is z
- The production function $F(K, N)$ is neoclassical
 - Diminishing returns to capital
- For example, the Cobb-Douglas production function:
$$Y = zK^{\alpha}N^{1-\alpha}$$
- Parameter α estimated using capital share of income

Capital Accumulation

- Changes in the amount of capital accumulated per worker are explained by the difference between:
 - $szf(k)$ = amount of saving, and hence investment, per worker
 - Saving rate s multiplied by per-worker production function $y = zf(k)$.
 - $(d + n)k$ = amount of investment per worker needed to sustain same level of capital per worker next year
 - A fraction d of all capital depreciates, so an amount of capital per worker dk must be replaced to keep the capital per worker unchanged.
 - The number of workers increases by a percentage n each year, so if existing workers use capital k each, there needs to be investment nk per existing worker to give future workers the same capital k each.

Singapore: National Saving Rate

