



Problem sets 6: One-period general equilibrium model

EE312: Intermediate macroeconomics

Semester 1/2019

Instructor: Asst. Prof. Dr. Kittichai Saelee

Due on November 13th, in class before 11.15 am

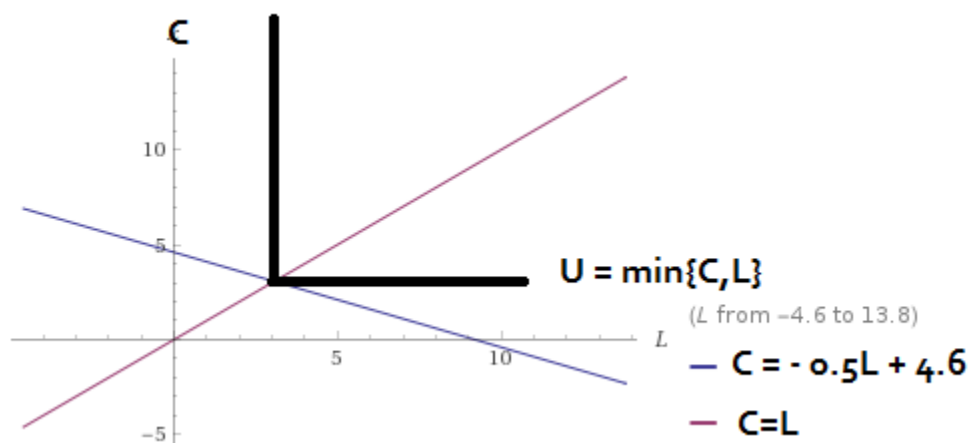
Questions in Williamson (Use the 2017 edition)

1. Chapter 4: Q3, Q4, Q7, Q12, Q13, and Q16

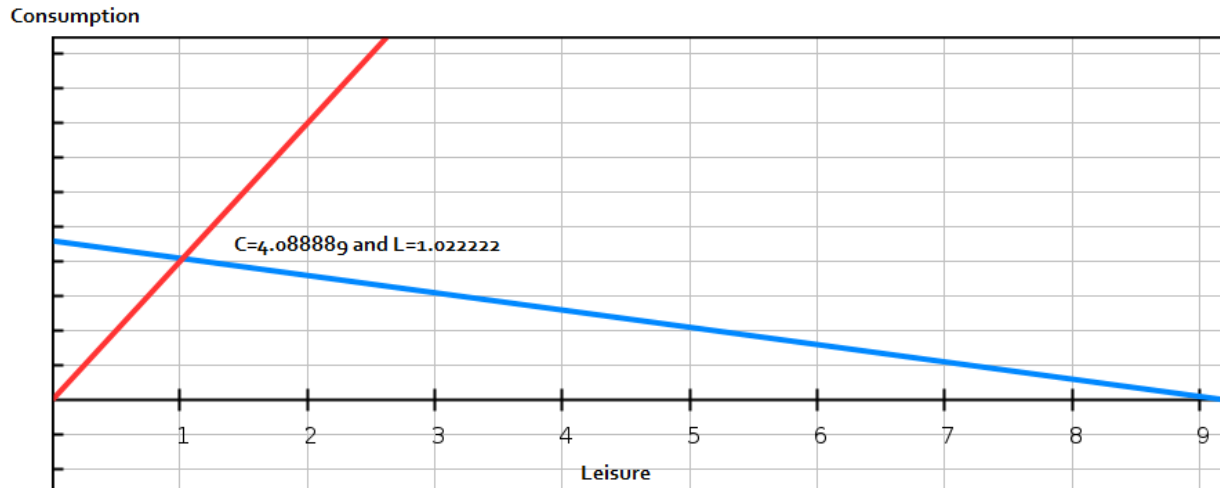
Question 3

a) Given that $h = 16$, $w = 0.5$, $\pi = 0.6$, and $T = 4$, the budget constraint can be then represented by $C = -0.5L + 4.6$.

Using the budget constraint and the fixed proportion rule ($C=L$), we yield that $C = 3.06$, and hence L . Note that maximum leisure taken by the household is equal to 9.2 hours; household need to work at least $12 - 9.2 = 2.8$ hrs.



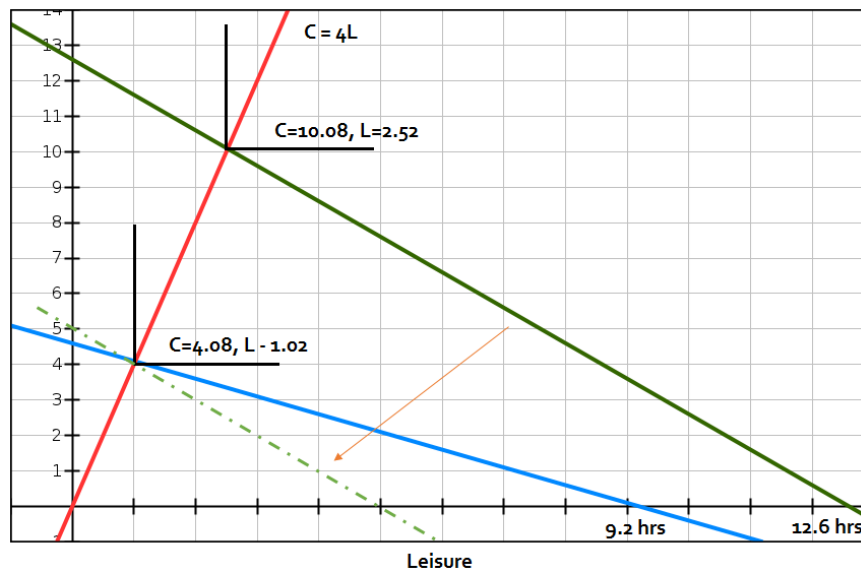
b) With the new proportional rule where consumer choose 4 units of C and 1 unit of leisure, this implies that the ratio of consumption to leisure is equal to 4, i.e. $C/L = 4$. Given this information we yield that $C = 4.08$ and $L = 1.02$



c) When W increases to 1 (increased double), the new budget constraint can be represented by

$$C = 12.6 - L.$$

With the proportional rule given by (b), we yield that $L = 2.52$ and $C = 10.08$.



As the decision rule is the fixed proportion, there is not substitution effect. The impact of price change on optimal consumption and leisure is entirely due to the income effect.

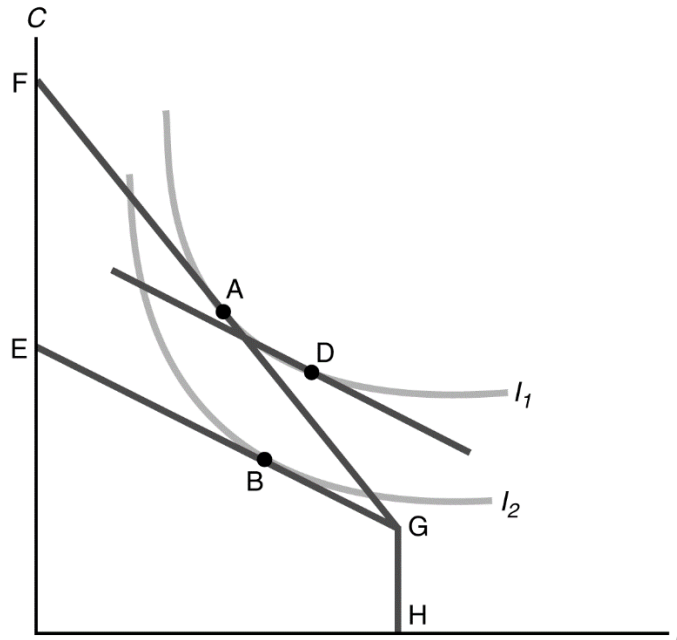
Question 4

When the government imposes a proportional tax on wage income, the consumer's budget constraint is now given by:

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

where t is the tax rate on wage income. In the figure below, the budget constraint for $t = 0$, is FGH. When $t > 0$, the budget constraint is EGH. The slope of the original budget line is $-w$, while the slope of the new budget line is $-(1-t)w$. Initially the consumer picks the point A on the original budget line. After the tax has been imposed, the consumer picks point B. The substitution effect of the imposition of the tax is to move the consumer from point A to point D on the original indifference curve. The point D is at the tangent point of indifference curve, I_1 , with a line segment that is parallel to EG. The pure substitution effect induces the consumer to reduce consumption and increase leisure (work less).

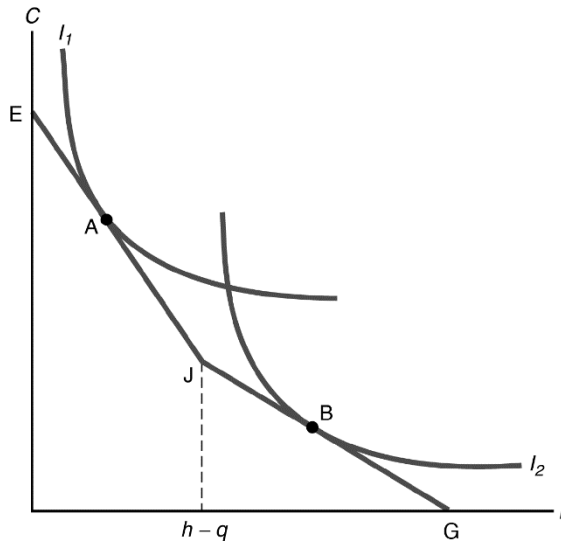
The tax also makes the consumer worse off, in that he or she can no longer be on indifference curve, I_1 , but must move to the less preferred indifference curve, I_2 . This pure income effect moves the consumer to point B, which has less consumption and less leisure than point D, because both consumption and leisure are normal goods. The net effect of the tax is to reduce consumption, but the direction of the net effect on leisure is ambiguous. The figure shows the case in which the substitution effect on leisure dominates the income effect. In this case, leisure increases and hours worked fall. Although consumption must fall, hours worked may rise, fall, or remain the same.



Question 7

This problem introduces a higher, overtime wage for hours worked above a threshold, q . This problem also abstracts from any dividend income and taxes.

- (a) The budget constraint is now EJG in the figure below. The budget constraint is steeper for levels of leisure less than $h - q$, because of the higher overtime wage. The figure depicts possible choices for two different consumers. Consumer #1 picks point A on her indifference curve, I_1 . Consumer #2 picks point B on his indifference curve, I_2 . Consumer #1 chooses to work overtime; consumer #2 does not.



- (b) The geometry of the figure above makes it clear that it would be very difficult to have an indifference curve tangent to EJG close to point J . In order for this to happen, an indifference curve would need to be close to right angled as in the case of pure complement. It is unlikely that consumers wish to consume goods and leisure in fixed proportions, and so points like A and B are more typical. For any other allowable shape for the indifference curve, it is impossible for point J to be chosen.
- (c) An increase in the overtime wage steepens segment EJ of the budget constraint, but has no effect on the segment JG . For an individual like consumer #2, the increase in the overtime wage has no effect up until the point at which the increase is large enough to shift the individual to a point like point A . Consumer #2 receives no income effect because the income effect arises out of a higher wage rate on inframarginal units of work. An individual like consumer #1 has the traditional income and substitution effects of a wage increase. Consumer #1 increases her consumption, but may either increase or reduce hours of work according to whether the income effect outweighs the substitution effect.

Question 12

Lump-sum tax does not affect firm's marginal cost, and hence should not affect anything to firm's decision. Labor demand should be the same.

Question 13

The firm chooses its labor input N^d so as to maximize profits. When there is no subsidy, profits for the firm are given by

$$\pi = zF(K, N^d) - wN^d.$$

That is, profits are the difference between revenue and costs. In the top figure on the following page the revenue function is $zF(K, N^d)$ and the cost function is the straight line, wN^d . The firm maximizes profits by choosing the quantity of labor where the slope of the revenue function equals the slope of the cost function:

$$MP_N = w.$$

The firm's demand for labor curve is the marginal product of labor schedule in the bottom figure below.

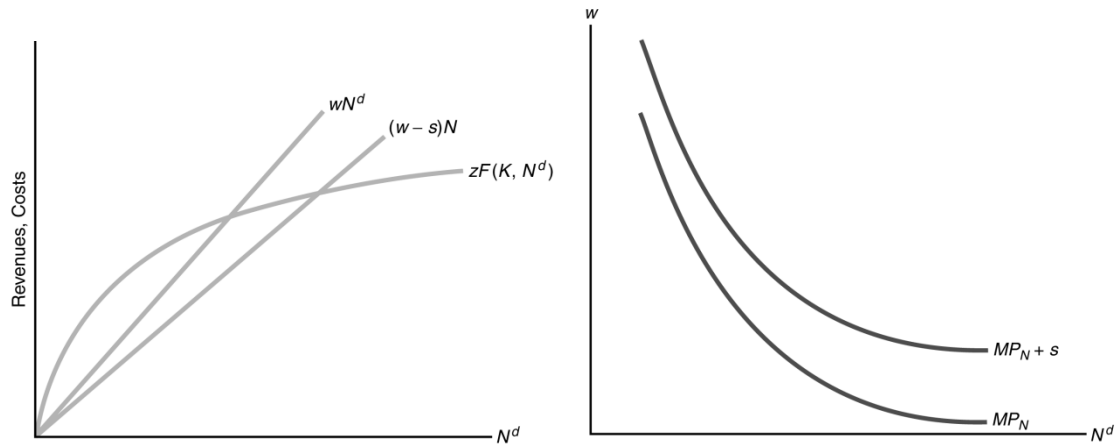
With an employment subsidy, the firm's profits are given by:

$$\pi = zF(K, N^d) - (w - s)N^d$$

where the term $zF(K, N^d)$ is the unchanged revenue function, and $(w - s)N^d$ is the cost function. The subsidy acts to reduce the cost of each unit of labor by the amount of the subsidy, s . In the top figure below, the subsidy acts to shift down the cost function for the firm by reducing its slope. As before, the firm will maximize profits by choosing the quantity of labor input where the slope of the revenue function is equal to the slope of the cost function, $(w - s)$, so the firm chooses the quantity of labor where

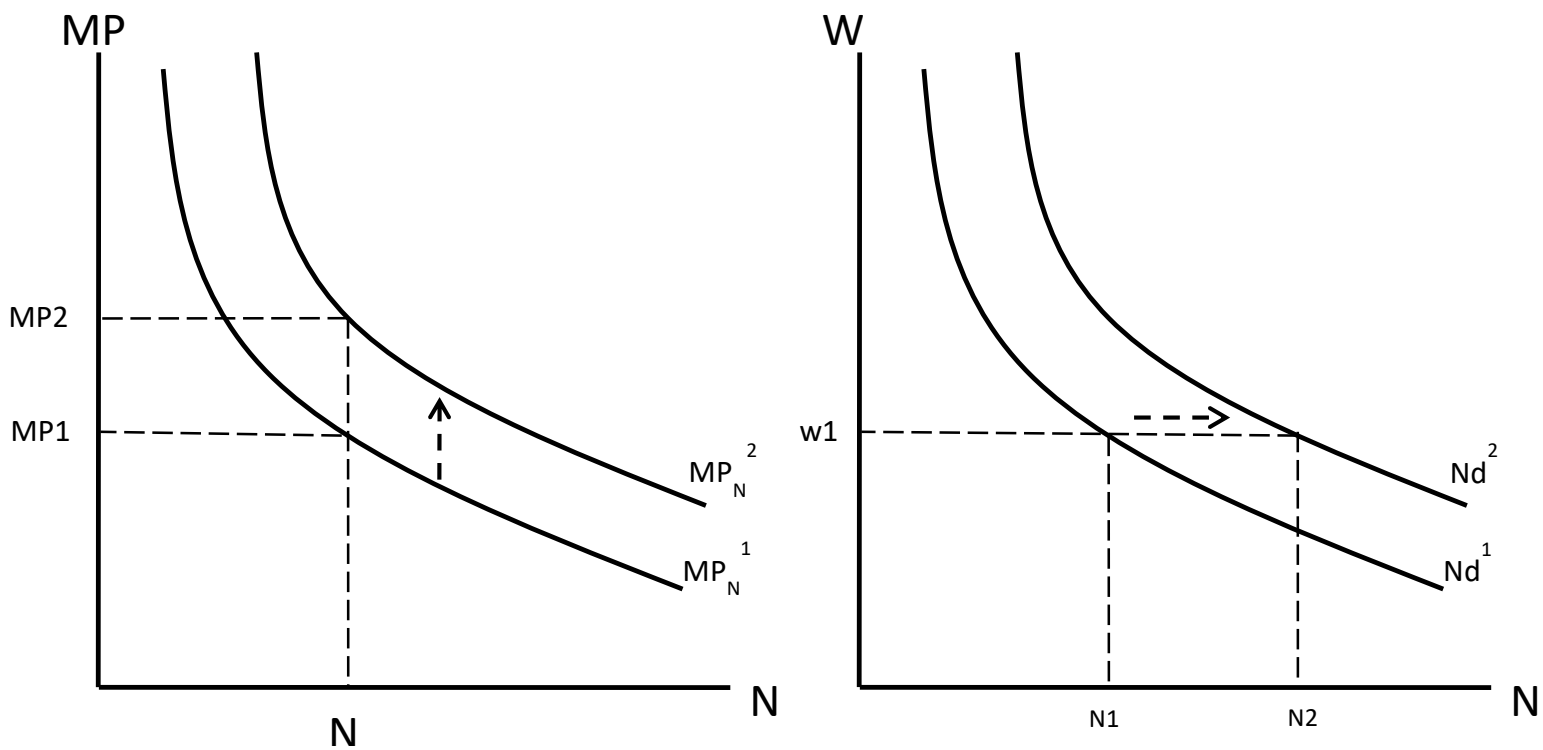
$$MP_N = w - s.$$

In the bottom figure below, the labor demand curve is now $MP_N + s$, and the labor demand curve has shifted up. The subsidy acts to reduce the marginal cost of labor, and the firm will hire more labor at any given real wage.



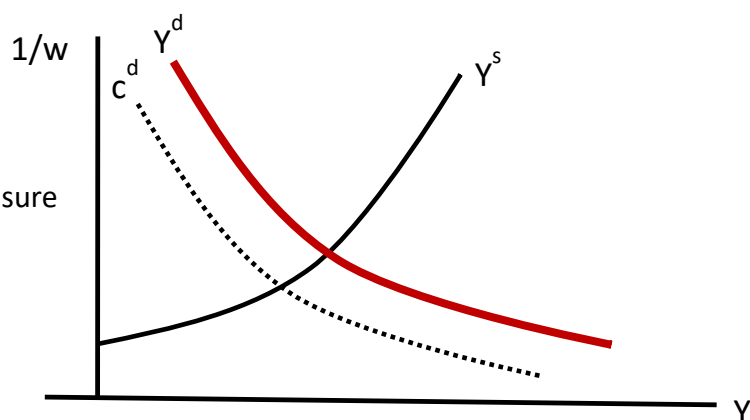
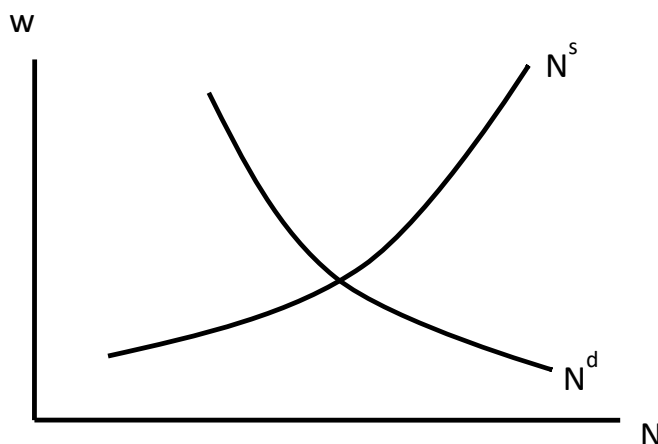
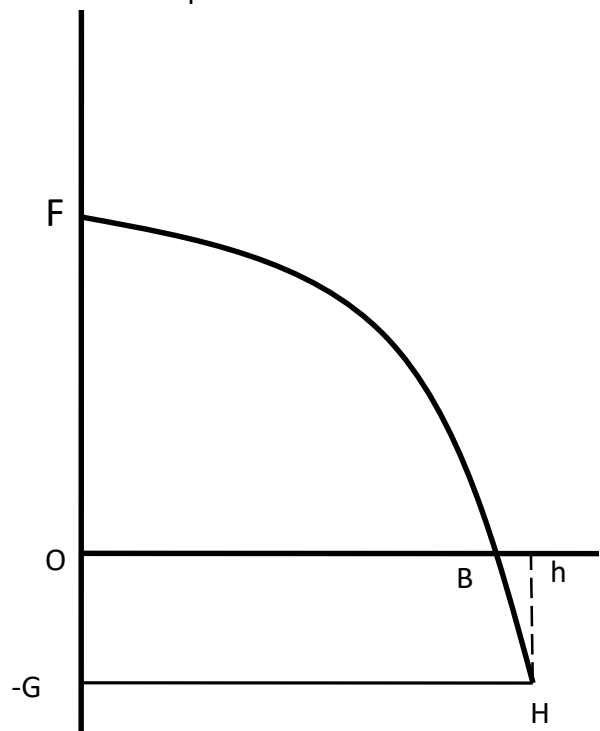
Question 16

As given in the problem, the adoption of clean technology increases firm's productivity. As a result, this will increase the marginal productivity of labor curve for every level of employment, and hence an increase in the labor demand for every level of market wage. The figure below illustrates the impact of an increase in productivity of labor, arising from the adoption of clean technology.



2. Use the figures below, and redo the analysis discussed in class. Start with the opposite situation. Assume that when $W = 10$, the economy is experiencing *an excess demand in labor*. Locate all the points that represent the initial situation. Explain step-by-step why all the located points make sense. Then, analyze the adjustment mechanism and determine the possible competitive equilibrium.

Private consumption

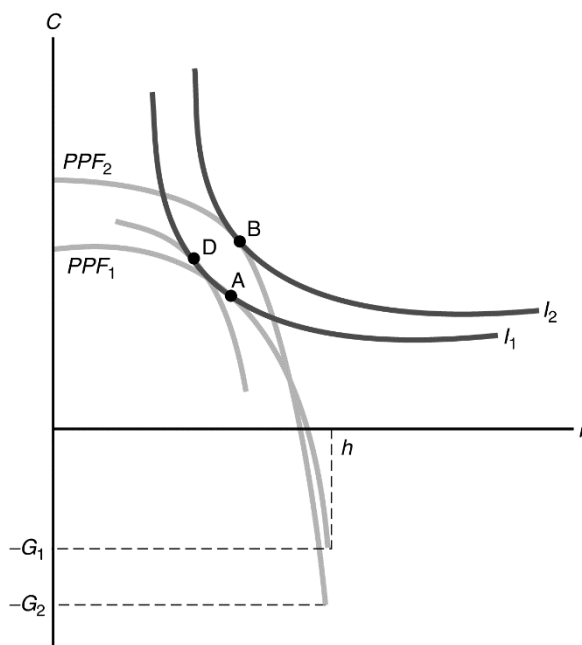


3. *Government spending and productivity*

In class, we discuss about the case for which government spending is wasteful in the sense that households receive no benefit from the spending. In the real-world example, tax-financed spending can generate some extra benefit to the society. For example, government spending can be used for the investment on infrastructure, which can potentially raise the level of overall productivity of a nation. Use the graphical approach that we discussed in class, and consider the overall impact of an increase in government spending when the spending can raise the level of technology. Start from the initial situation and develop your own presentation step-by-step. Showing all the possible effects of an increase in government spending. Combined each effect and discuss the possibilities of the final outcomes, both equilibrium and welfare comparison. Explain what would happen to output, private consumption, leisure, real wage and household welfare. When do you expect household welfare to increase?

Production-enhancing aspects of government spending.

- (a) The increase in government spending in this example has two separate effects on the production possibilities frontier. First, the increase in government spending from G_1 to G_2 implies a parallel downward shift in the production possibilities frontier. Second, the productive nature of government spending is equivalent to an increase in total factor productivity that shifts the production possibilities frontier upward and increases its slope. The figure below draws the original production possibilities frontier as PPF_1 and the new production possibilities frontier as PPF_2 . If the production-enhancing aspects of the increase in government spending are large enough, representative consumer utility could rise, as in this figure.



- (b) There are three effects at work in this example. First, there is a negative income effect from the increase in taxes needed to pay for the increased government spending. This effect tends to lower both consumption and leisure. Second, there is a substitution effect due to the productive effect of the increase in G , which is drawn as the movement from point A to point D. This effect tends to increase both consumption and leisure. Third, there is a positive income effect from the increase in G on productivity. This effect tends to increase both consumption and leisure. In the figure above, the movement from point D to point B is the net effect of the two income effects. In general, consumption may rise or fall, and leisure may rise or fall. The overall effect on output is the same as in any increase in total factor productivity. Output surely rises.