Development Economics – Exam

Spring 2021

Question 1) Income and population

Why is it difficult to compare income per capita between low- and high-income countries? Why might low-income countries experience rapid population growth as their income increases?

Income per capita is a way to measure economic development, and examples include Gross Domestic Product (GDP) and Gross National Income.

GDP is measured in a country's own currency. In Norway we would use NOK, and in the US, they would use US dollars. To compare income per capita between low- and high-income countries it is necessary to use exchange rate methods to create comparable incomes. There are two types of exchange rates, PPP or market exchange rates. However, an issue with the market exchange rate is that it can vary depending on supply and demand in foreign exchange markets which can give inaccurate measures.

GNI is a country's total amount of domestic and foreign output by the population. This measures the overall well-being of countries population in terms of the average population's purchasing power. This measure is often used to compare economic development across countries. Here we have to use a foreign exchange rate method to convert countries' currencies into for example US dollars, but it is also important to consider the relative domestic purchasing power. We can use the purchasing power parity (PPP) to adjust the GNI per capita, which aims to compare the purchasing power of for example a US dollar, taking the different prices of goods and services of a country into account. Low-income countries are characterized by having cheaper goods relative to high-income countries. It is important to take the domestic purchasing power into consideration because it will give a better measure of living standards based on the income and price levels, and the actual difference in purchasing power across countries will be smaller and more accurate to if we didn't take purchasing power into account when measuring the GNI p.c.

The difficulty with using income per capita to measure differences between low- and high-income countries is that GNI and GDP measures the average of the population, which may not represent the living standards in an accurate manner. This is because income per capita doesn't consider inequality in income. In high-income countries the average income may be high, but it doesn't take into account that there may be a small percentage of the population that accounts for big parts of the country's income and many may live in bad conditions.

An alternative way of measuring economic development is the human development index (HDI). This index takes a variety of different dimensions into account and attempts to say something about development relative to the well-being of the population. The new version of this measure, the NHDI, allows imperfect substitutability between three components:

1. Health – life expectancy at birth
2. Education – average schooling years for adults and expected schooling attainment for children
3. Income – measure by real p.c. GDP adjusted for PPP, also assuming diminishing marginal utility of income

Other issues with using income p.c. to measure economic development includes: *Exchange rate movements*, which means that fluctuation in exchange rates will change the national income but won't necessarily reflect the change in the population's income or well-being. The variation in prices of tradeables and non-tradeable goods is that they are relatively cheaper in low-income countries compared to high-income countries. In especially developing countries there is often a big part of the population living and working in the rural sector, where there is an issue with non-market production. Individuals may produce farming for their own consumption, which won't be taken account for when the country's output is measured. Production and consumption *in the informal sector* are another issue as this will also not be accounted for when measuring output, and informality and non-market production may contribute to exaggerating differences in the well-being of a country's population.

Income per capita predict important outcomes for a country's population, especially in developing countries, but it is overall not a good measure of economic development.

Population growth is an important aspect of economic development. We can characterize low-income countries with having high infant mortality rates, very high birth rates compared to

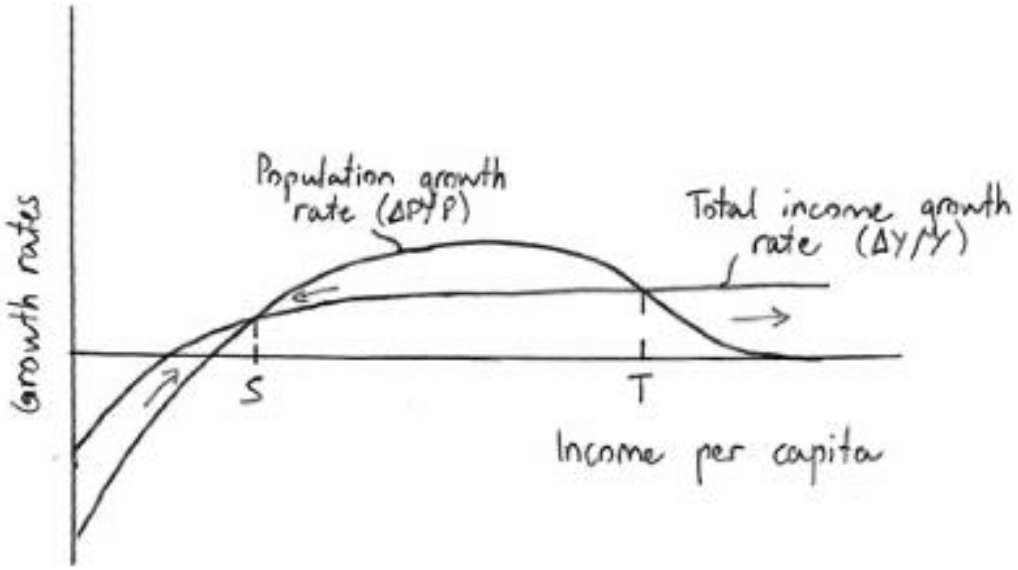
high-income countries, and low life expectancy. This is an issue often surrounding bad health conditions, nutrition and infrastructure. As low-income countries experience increased income and move towards middle-income countries, they might experience rapid population growth. With increased income, the population can afford more food, access to clean water, health care, better education, all parts that lead to better living standards. Middle-income countries are characterized by still having high birth rates and significantly reduced infant mortality rates, and also higher life expectancy than in low-income. In high- and low-income countries there are certain patterns that suggests that there is a correlation between population growth and economic growth. The demographic transition from a low-income country to a high-income country consists of three stages:

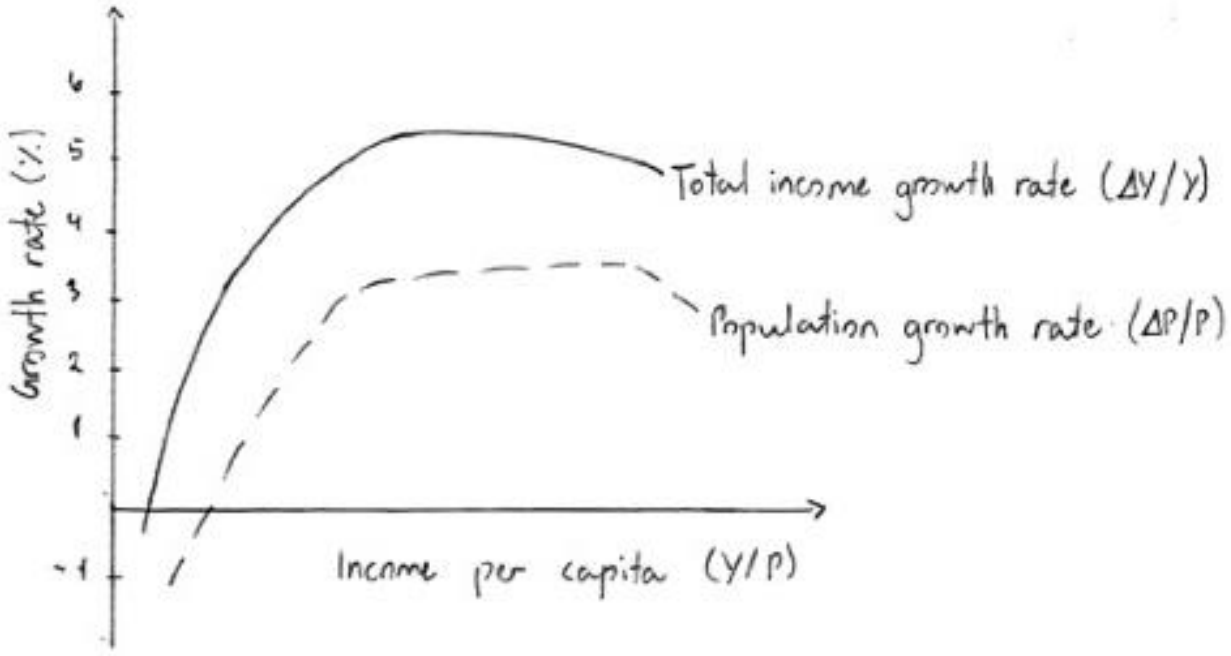
1. Stage 1 – high birth rates and death rates (low)
2. Stage 2 – continued high birth rates and decreasing death rates
3. Stage 3 – growth is stabilizing, decreasing high birth rates and death rates

There will therefore be rapid growth in population when an economy moves from low-income to middle-income, but when it moves toward high-income, it tends to stabilize.

Uncontrolled, rapid population growth in low-income economies can lead to a poverty trap. A poverty trap is when there are mechanisms that tend to trap countries in low-income or low living standard equilibriums.

As we can see from the first figure below, when an economy reaches an income p.c. of S the population will grow uncontrollably. The scenario in the second figure would be more optimal. When the population starts growing uncontrollably, it will push the income p.c. down towards S again. This poverty trap is driven by a high growth in population. If the economy reaches an income level p.c. higher than T, they will have stabilized the population growth, and will avoid the trap. The curve of total income growth flattens out and reflects diminishing marginal returns and suggests that savings becomes easier above some level of income. As they reach a middle-income economy it will be a high rate of savings in the economy, and it will be easier to increase the income level further. Technological progress that increases productivity in the economy makes it so they can completely avoid this trap, even with rapid population growth.


Growth rates
Population growth rate (ΔP/P)
Total income growth rate (ΔY/Y)
S
T
Income per capita


Growth rate (%)
6
5
4
3
2
1
-1
Total income growth rate (ΔY/Y)
Population growth rate (ΔP/P)
Income per capita (Y/P)

Question 2) Growth

*What do we mean by steady state growth in a Solow Model? What prediction does this give regarding convergence? How does this prediction change if countries can accumulate both physical **and** human capital?*

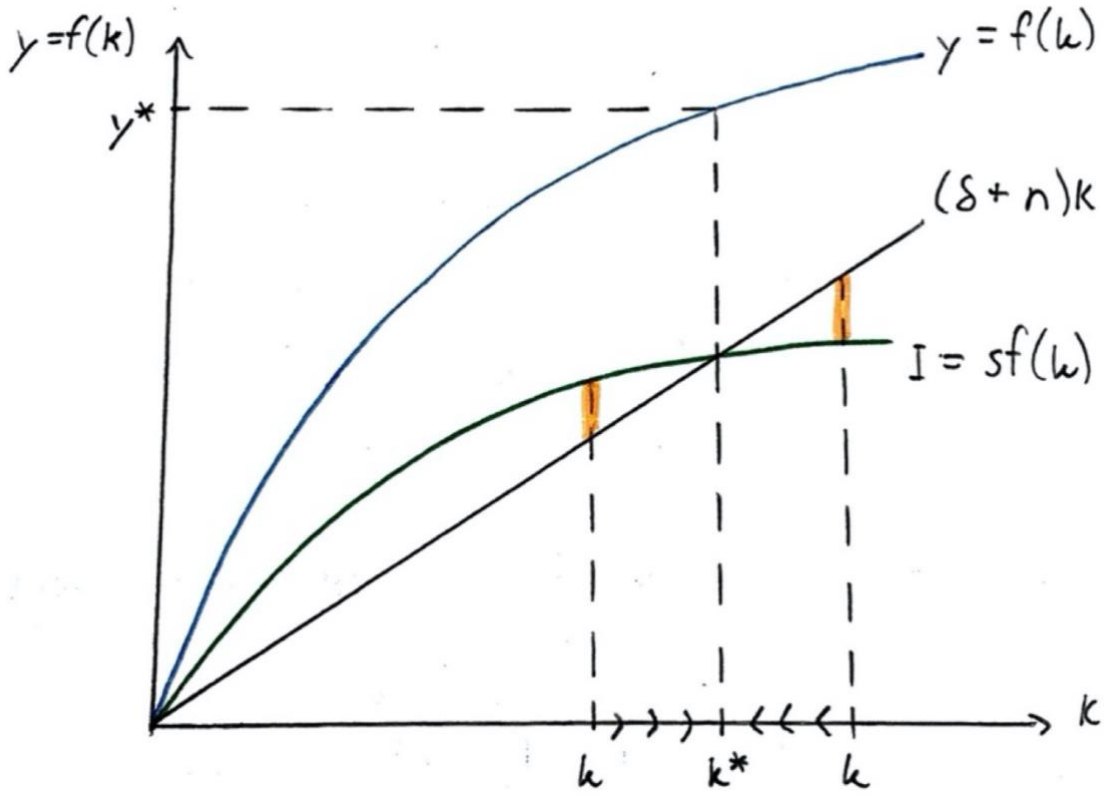
The Solow Model can be used explain economic growth by looking savings, capital accumulation and productivity, and what prediction it gives regarding convergence. In the augmented Solow model, we include technological progress, and we look at the process regarding capital per efficient unit of worker instead of only capital per worker.

<u>The Solow model</u>

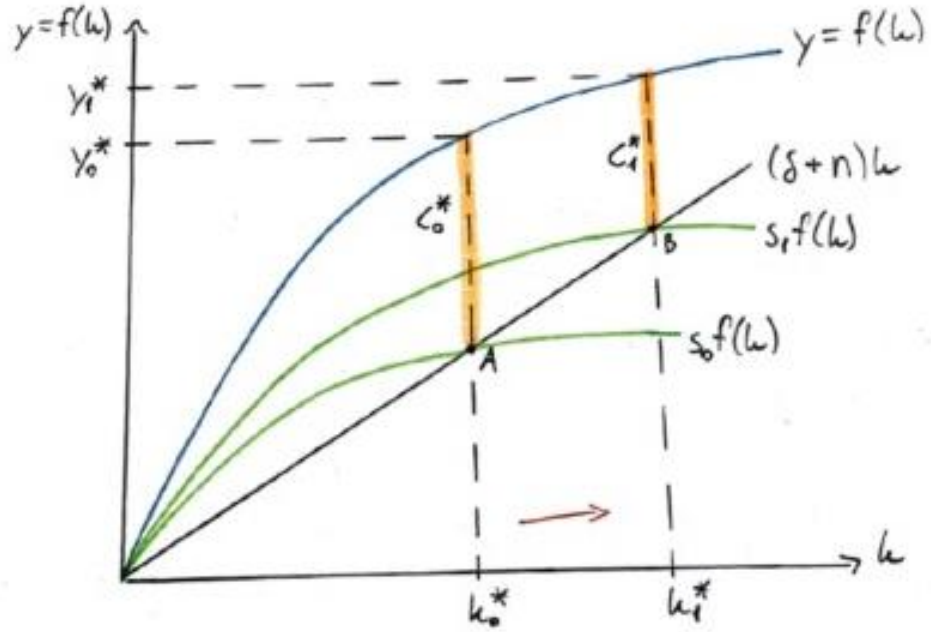
The Solow equation:

$\Delta k = sf(k) - (\delta + n)k$

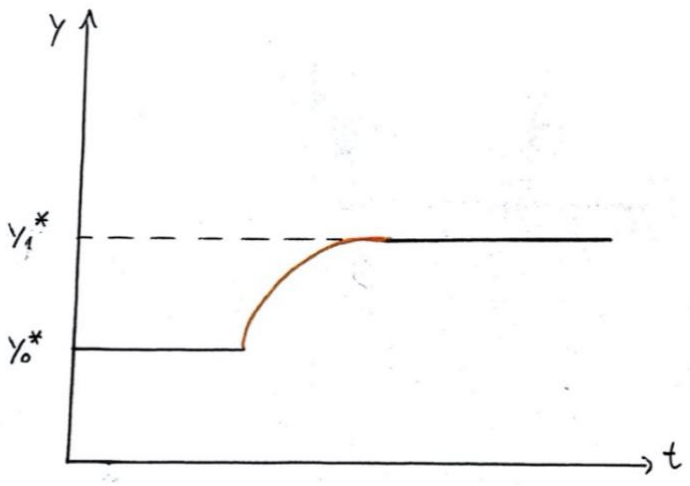
This equation shows the growth of the capital to labor ratio, k, and is a function of savings (=investments), depreciation and population growth.



The Solow Model assumes diminishing marginal returns to capital, which means that an increase in the savings rate only will lead to short-term growth. This is due to the prediction of the steady state, which means that we will converge towards an equilibria state of capital per efficiency unit, k*. If we look at a country with initial capital level lower than k*, there will be a period with increased capital and production, and therefore economic growth, until it reaches the steady state. If a country has initial levels of capital higher than k*, depreciation will be greater than investments, and the capital levels will decrease until it reaches the steady-state k*.



An increase in savings can result in temporary economic growth where capital and production increase until they reach new equilibrium levels. Increasing the savings rate, s, can however not lead to higher growth in the long run. Only an increase in productivity can lead to permanent economic growth, as seen in the figure below.



Convergence in per capita income is the idea that economies will end up in the same state with approximately the same per capita income levels and can also be called the catch-up effect as it implies that per capita income tend to grow faster in low-income countries compared to high-income countries. Conditional convergence predicts that countries with the same s, n, and δ will converge towards the same income level. Unconditional convergence suggests that all economies will end up in a steady state with the same p.c. income levels regardless of initial starting point.

The Solow model predicts that economies with the same s, n, and δ will converge to the same p.c. income. The Solow model suggests that returns to capital is higher when an economy is further away from the steady state. This implies that returns on physical capital should be higher in these countries, but there is little evidence to back this up.

As seen, the Solow model assumes a fixed production function, which isn't a realistic assumption. The augmented Solow Model takes into account that there can be technological progress, meaning that you can produce more with a given stock of capital.

We can think of technical progress as individuals becoming more productive such that

$$L(t) = E(t)P(t)$$

Where
L(t) – the amount of effective labor used in production
P(t) – population
E(t) – productivity of labor

Technical progress, π, can be defined as a growth rate of E, which defines how quickly production gets more effective:

$$\pi = \frac{E(t+1) - E(t)}{E(t)}$$

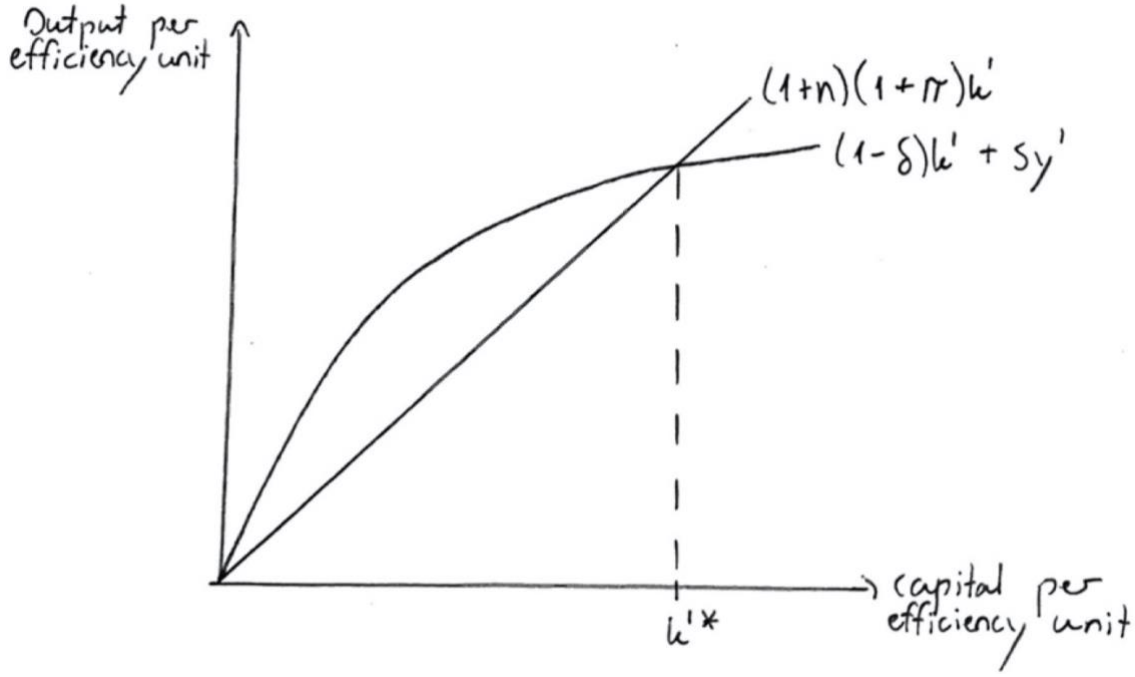
<u>The augmented Solow model</u>

$$(1+n)(1+\pi) = (1-\delta)k' + sy'(t)$$

where

k' – per efficiency unit of labor levels of capital

y' – per efficiency unit of labor levels of income



Also in the augmented model will there be a steady state that converges towards, now, k'*. Long run growth will be a function of this technical progress, as we can add more capital every period because labor gets more and more productive and will be the only way to go beyond the standard steady state from the original Solow model.

In the Solow model we look at accumulation of capital, and the labor force grows due to population growth. In a human capital augmented growth model, we can accumulate both physical capital and human capital, for example education. We have a new production function:

$$y = k^{\alpha} h^{1-\alpha}$$

where the second factor is human capital instead of labor. Alpha defines what the best mix of human and physical capital will be if we have a given budget constraint curve.

The economy can now save and invest in physical capital and human capital. In the long run the growth rates of physical and human capital will be the same, because they are complementary and have diminishing marginal return:

$$sr^{1-\alpha} = qr^{-\alpha}$$

This model predicts that economies will converge towards similar growth rates in both human and physical capital, and also in income. However, it predicts that there will not be a tendency for economies to converge towards the same p.c. incomes.

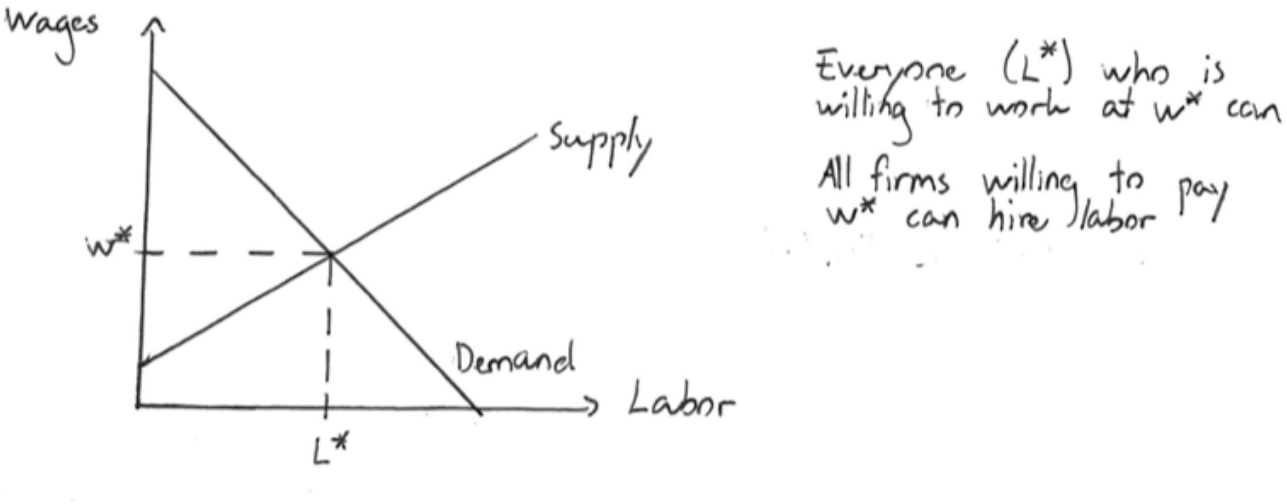
This model also predicts that economies will conditionally converge. It suggests that if we hold the level of human capital constant, low-income countries will grow faster. It also suggests something we can call conditional divergence, which means that if we hold the GDP p.c. constant, countries with more human capital will grow faster. This results in high-income countries, that typically have more human capital per worker, will grow faster. However, the model also predicts that because of the steady state, higher income countries will have decreasing growth patterns. These two predictions are contradictory and will weaken the suggested effect on convergence.

Question 3) Labor

How can undernutrition lead to a poverty trap? How could long term contracts reduce these problems and why might firms be unwilling to provide them?

Malnutrition is a central issue in many developing countries. Compared to developing countries, developed countries have higher education levels, wage levels, and higher life expectancy. To show how undernutrition can lead to a poverty trap, it is important to look at the relationship between nutrition and labor income.

The standard model of labor markets:



where

S – supply

D – demand

L – labor

w - wages

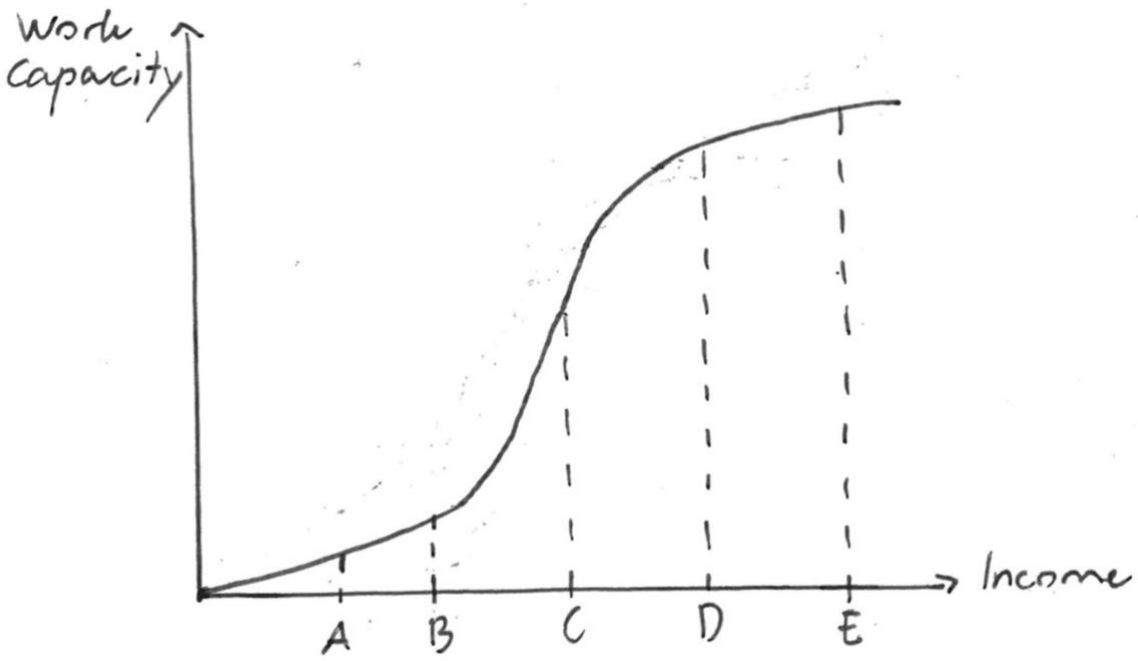
In (L*, w*) everyone who wants to work at the equilibrium wage, w*, can, and all businesses that wants to offer wage, w*, can hire from the supply pool. This model doesn't take into account that there are different types of labor contracts, labor efficiency will vary, and other uncertainties like seasonality and involuntary unemployment.

Model of nutrition:

An important issue is not taking levels of efficiency in labor into account, which can tell us something about the relationship between work capacity and nutrition. The model of nutrition

is based on the theory of energy balance, which consists of four components: Energy input, energy output, resting metabolism and storage. Energy input, output and resting metabolism are the key factors to increasing work capacity.

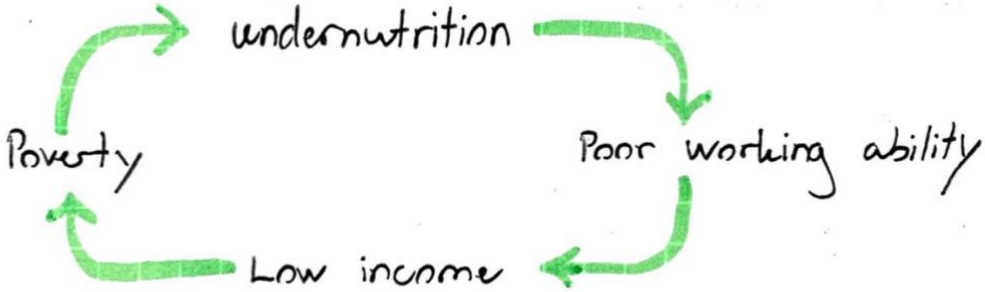
The capacity curve shows how nutrition will affect individuals' ability to work, assuming income = consumption.



What we can tell from the figure is that with increased income workers can buy more food, and therefore increase their work capacity. We can divide the curve into three:

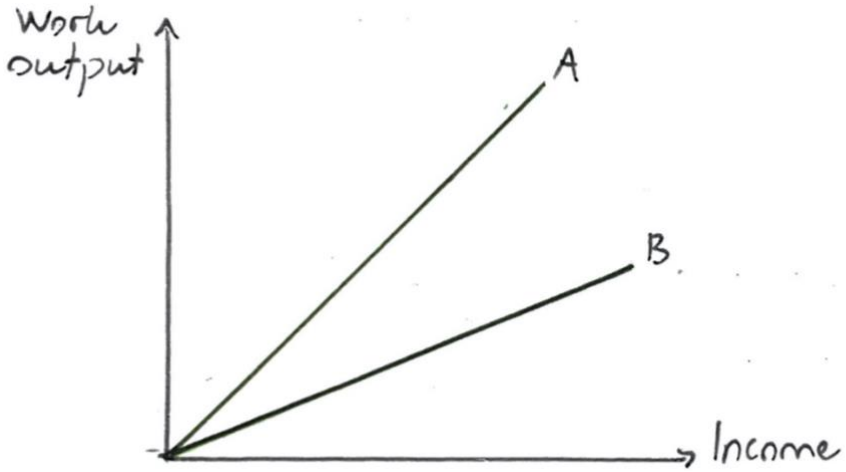
1. Low levels of income – any additional income will be used to reach the resting metabolism and will not have much on the workers work ability. We can see this in the figure from point A to B, where there is little effect on work capacity.
2. Mid-levels of income – additional income will in these levels be very effective on the workers capacity, as we can see from B to C. The required level of resting metabolism is met, and the added nutrition can therefore be put into work capacity.
3. High levels of income – when we reach a certain point, D, additional income won't have as much of an effect on work capacity. From point D to E there is relatively small gains in work ability, and they can therefore spend the additional income on other consumption.

The model of nutrition can be thought of as a circular relationship between nutrition and labor, as we can see in the figure below.



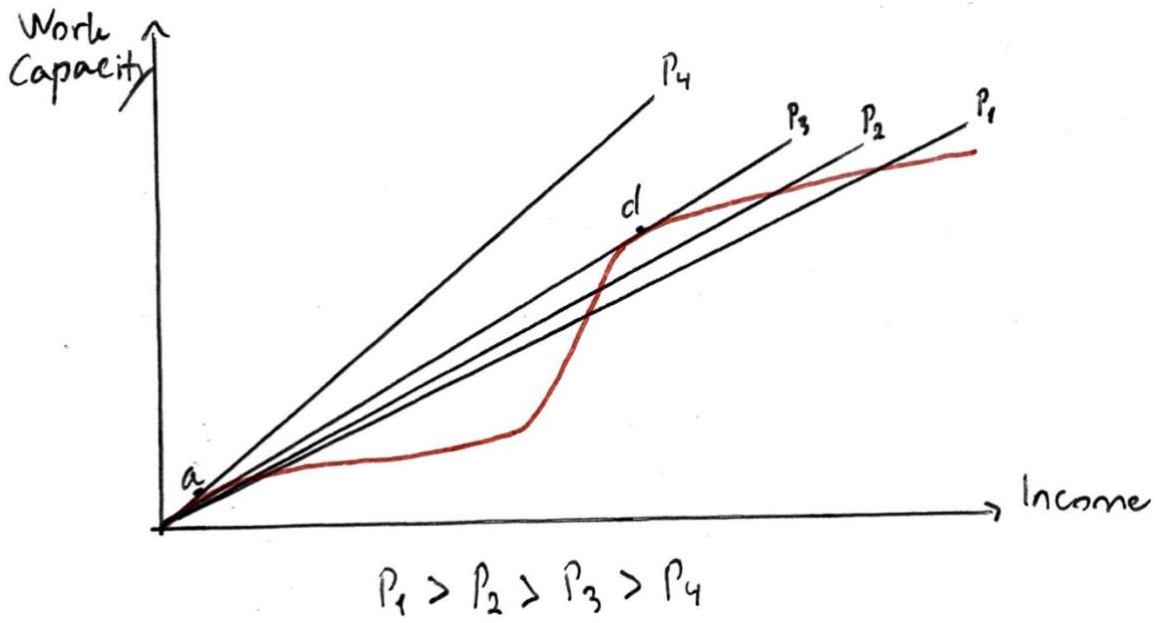
Undernutrition will lead to low levels of work capacity, resulting in low income and poverty, that again leads to malnutrition. This poverty trap can be called the low-productivity low income, which can be very hard to escape.

Piece rates are payments on per unit produced and can be used to define workers' output. Assume two piece rates, A and B, which shows what level of income workers can get based on their output.



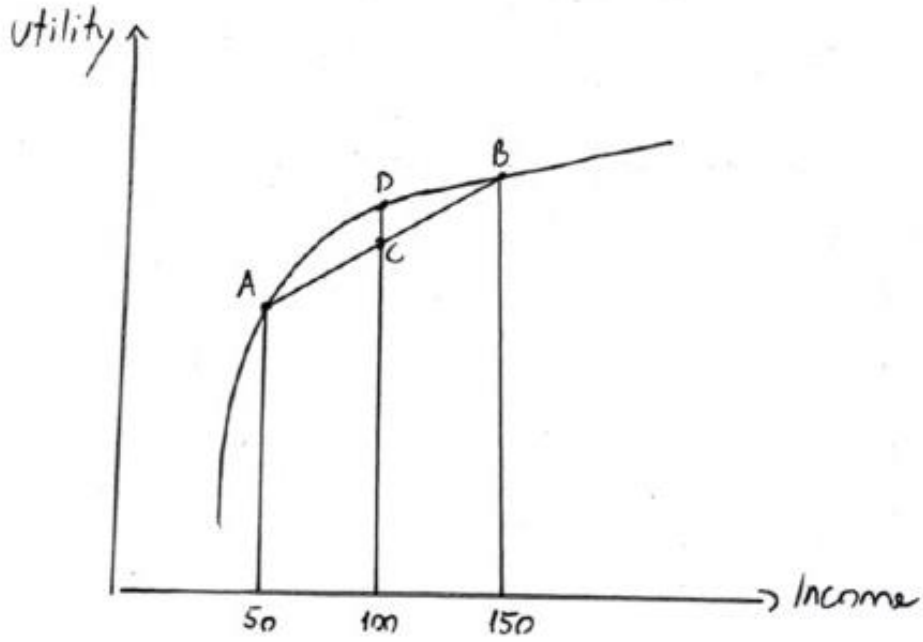
Can see from the figure that piece rate B will have higher income for less output to work than A, which means that a worker earning a piece rate A has to work more to have the same

income as a worker receiving piece rate B. We can look at the relationship between the piece rates and the capacity curve.



Piece rates P1, P2 and P3 will give a high income and therefore increasing work capacity. Piece rate P4 needs very high levels of output, resulting in a work capacity level in point a. The workers receiving piece rate P4 will therefore be stuck in a low-income low-output poverty trap, as they will not have enough income to surpass the level of resting metabolism and energy input required to increase work ability significantly.

Long term contracts are a central concept in reducing these problems, but firms often may not be willing to provide such contracts even though it can make both parties better off. In developed countries this is very much standard practice, but in developing countries the labor market can be characterized with high levels of casual labor without any sort of long-term contracts. In the rural sector there are factors like seasonality and income fluctuation to consider. High and low season means that the first will be characterized with high levels of demand of labor, while the latter demand less labor. There is no way of knowing if the next season will be high or low, and there will be an issue regarding if the workers are fluctuation averse or not. To be fluctuation averse means to prefer a fixed-sum income over a fluctuating income that averages at the same amount.



As an example, we can imagine that the worker can choose between 100 in both the high and low season and get utility of D, or they can choose 50 in the low season and 150 in the high season, this will average the utility of C. As we can see in the figure, the utility in C is lower than in D. A fluctuation averse worker will therefore rather choose a fixed income of 100 in both high and low season.

If the worker is risk-neutral however, they won't mind the fluctuations in income and can come up with something that will make both the worker and firm better off. A long-term contract is an example, because risk-neutral workers will be willing to take less than the average payoff than with fluctuations.

Firms may not be willing to sign these types of contracts because they don't know the worker's actions. The worker would then get 100 in the low season and also 100 in the high season. There would be incentives for the worker to first be overpaid at the first farm in the low season, and then move to another farm with low season and be overpaid again. The firms would then face higher costs. This can explain why firms would rather enter short-term contracts over long-term contracts.

Question 4) Transformation

Describe the process of transformation of an economy from a traditional agricultural setting to a more modern manufacturing economy. Why is the presence of surplus labor important and why does the process of migration to urban areas eventually slow down?

We can use the Lewis Model to describe how the transformation of an economy from a traditional agricultural setting to a more modern manufacturing economy. An important feature of developing countries is that they often consist of a large agricultural-based economy, where a significant proportion of the population live and work in rural areas. It is a fundamental part of development to move to a more urbanized state, where the surplus labor from the agricultural sector is moved to the manufacturing sector. The Lewis two-sector model explains how this shift from agricultural to urban sector happens, and how the internal migration will eventually slow down.

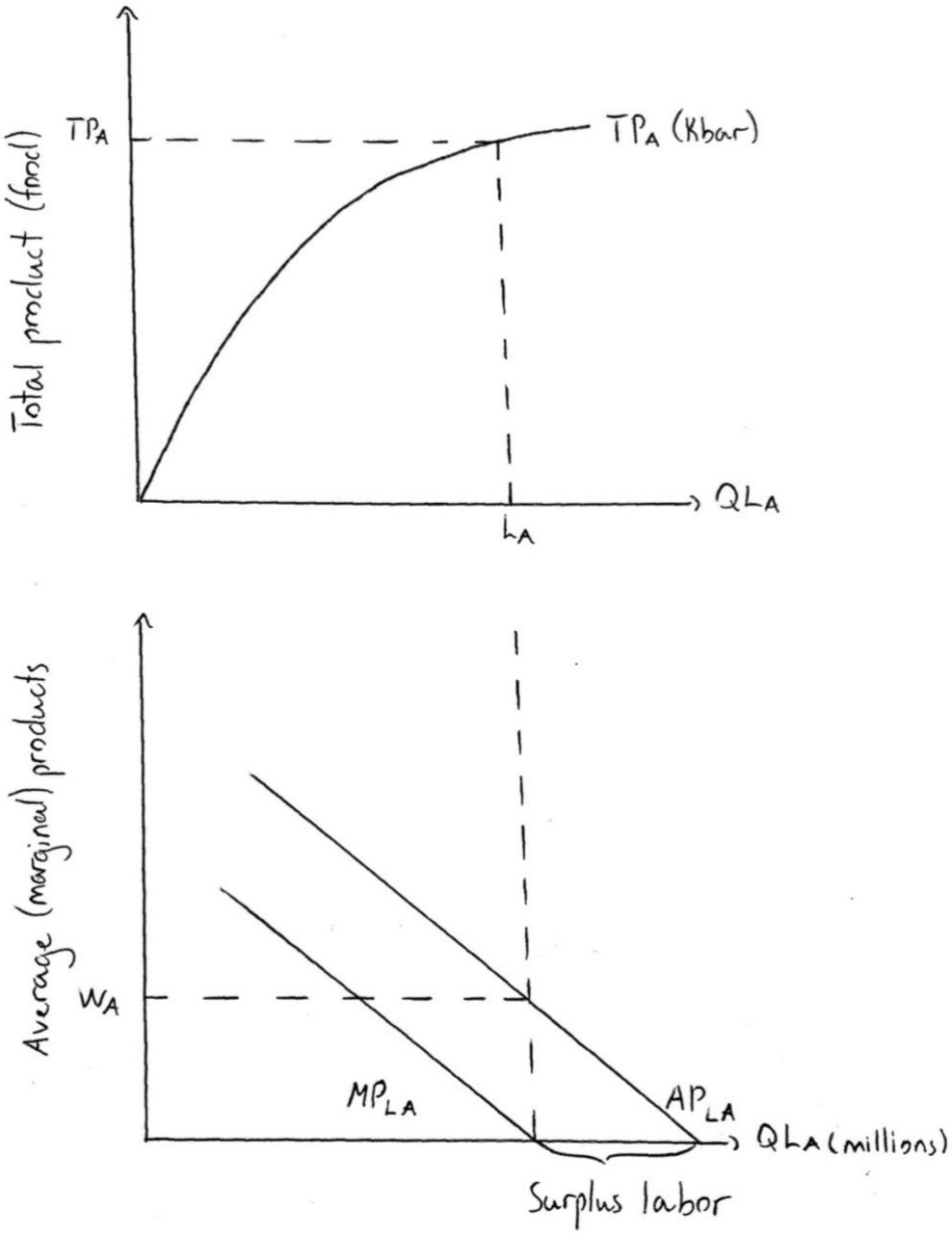
Assumptions:
In the model, the developing country consists of a rural subsistence sector and a high productivity urban sector. There is fixed capital and no technological change, and the rural sector creates a surplus of labor.

Total productivity in the agricultural sector is

$$TP_A = f(L_A, \bar{K}_A, \bar{t}_A$$

where the total product is a function of labor, capital and technology. Capital and technology are fixed, and any labor beyond L_A is surplus. This can be shown in the figure below.

Lewis model for the rural sector:



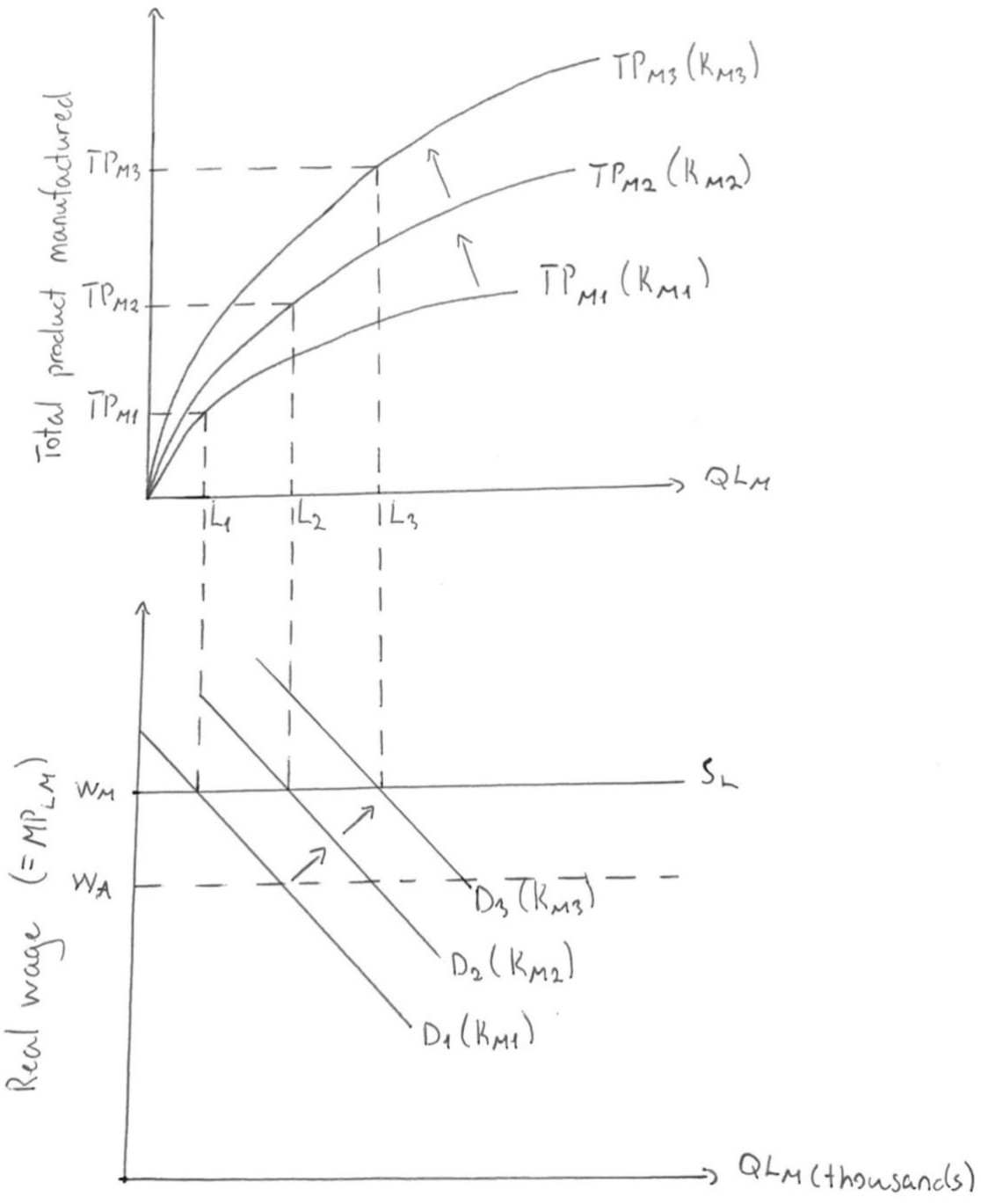
In the urban sector it is assumed to be a fixed, and higher wage level than in the rural sector. The manufacturing sector is characterized by being profit maximizing, using the profits to reinvest in capital which means that there will be capital accumulation over time. In developing economies, the urban sector will be significantly smaller in terms of employment, which means that the demand for labor will be much higher in the urban sector. The surplus labor from the agricultural sector, and the employers in the manufacturing sector will have a perfect elastic labor supply curve. At the fixed wage, w_M, urban employers can hire as many

workers from the agricultural sector as they want without affecting either the urban or rural wage, because the wage is fixed, and the sector is so small.

The total productivity for the manufacturing sector is given by:

$$TP_M = f(L_M, \bar{K}_M, \bar{t}_M)$$

Lewis model for the urban sector:



$$K_{M3} > K_{M2} > K_{M1}$$

Initially the urban sector will be in the lowest production function, but when manufacturers reinvest the profits to capital accumulation, this will lead to higher productivity and they can move towards K_{M3}. This results in increased demand for labor in the urban sector, moving from D_1 towards D_3. As long as there is surplus of labor in the rural sector, they can keep hiring without increasing the real wages. This is what we can call a process of growth and sectoral transformation, and the Sectoral transformation suggest that the growth of the manufacturing sector can happen without affecting agricultural production by hiring the surplus labor, at least until a certain point when there is no more excessive labor in the rural sector. To continue hiring will result in agricultural wages increasing, and there will eventually slow down and reach an equilibrium. This will stop the internal migration from growing further.

The issue with the model is that it assumes capital accumulation is labor neutral, which means that firms will keep investing in the same technology and won't invest in labor saving technology. This is unrealistic, as buying newer and more advanced technology can lead to more growth, and additional profits for the capital owners. It is also not very realistic that the model assumes fixed wages and no informal sector. Lastly, the model has also been criticized for assuming surplus labor in the agricultural sector and full employment in the manufacturing sector, when this is not the case in most developing economies.