Question 1 (25%) 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 the gross national income of a country divided by the population of that country. The GNI measures total income of residents in a country in that country's currency. One problem with comparing countries using income per capita is that if the countries have different currencies, the results cannot be easily compared. One would have to convert the value of the currency into the value in another currency used for comparisons, this is often the dollar. If we used the exchange rate on the day we chose to compare, we would see large differences between measured income per capita and the income per capita in the comparative currency. This is because exchange rates fluctuate, leading to differences in income per capita that are not reflected in the production of that country. One solution to this issue is to take the average exchange rate over a longer period. This way, the fluctuations would average out and we would use an exchange rate that more accurately reflected the country's actual income.

A few more problems arise when we compare income per capita between low and high income countries. The first is that production that is not traded is not accounted for in GNI. This means that production for own consumption will not be counted. Since subsistence farming accounts for a larger share of production in low income countries, it suggests that the income per capita of these countries are higher in reality than the measured number.

Another issue is that production that happens outside the formal sector is not counted either. This can be linked to criminality or just because of lack of formal institutions, but there is more informal activity in lower income countries, meaning that their reported income per capita is again probably lower than their real income per cap.

The third is that the value of non-tradeable goods an vary largely between countries. Since they cannot be traded, services such as barbers and cooks are likely to be cheaper in lower income countries. This means that a same amount of dollars has more purchasing power in low income countries. Again, this leads to reported income per capita being lower than the real income per cap.

All these issues mean that comparing income per capita between low and high income countries is difficult. If we disregard them, the income per capita in lower income countries will be lower than the actual income in these countries and lead to larger gaps between rich and poor than in reality. The unmeasured income in subsistence and informal sector lead to estimations having to be made and therefore margins of error. We can also adjust the income per capita to purchasing power, but the number would still not reflect actual numbers.

The second question is if these comparisons are any useful. We use income per capita to compare these countries because we assume that the number reflects economic development and welfare. This is not always the case. There is a correlation between income and welfare, but this mostly exists at low levels of income. If a poor country experiences an increase in income, they are likely to be able to afford cheap investments that drastically improve living conditions, such as access to clean water, better shelter or more efficient farming equipment. However, if a country is already at a high level of income, an increase is not necessarily associated with benefits to life expectancy or education.

The income per cap is the total income divided equally between every resident. We could also imagine that all income is earned by a few people. Meaning that increased income leads to no improvement for most people. This is unlikely but not impossible. Large inequalities mean that the effect of income can be small on welfare even in low income countries.

As I mentioned above, increases in income at a low level leads to cheap investments that can drastically improve living conditions. This can explain the growth in population associated with increased income. We can assume that the country starts at a state with high mortality and therefore large number of children per women. When the income starts to rise, the mortality rate can fall quickly because of access to vaccines and cheap medicine. The fertility rate will stay high because of habit and uncertainty of the duration of low mortality. This gap between mortality and fertility will lead to a large increase in population size. As the mortality appears to stay a stable low level, fertility rates will start to fall as well. The population growth will slow down and can eventually stabilize at a low mortality and low fertility rate.

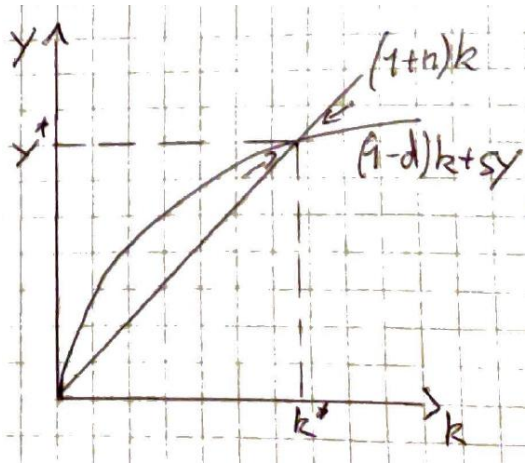
Question 2 (25%) Growth

*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?*

First, a quick rundown of the standard Solow model without human capital or technological progress. We are looking at a closed economy with no public sector with a constant rate of population growth, n. We also assume perfect financial markets such that savings equal investment. Capital depreciates a rate d but can be reinvested in with savings.

For the total amount of capital to increase, investments need to equal depreciation, but since we have population growth, we should be looking at capital per worker. The model uses a standard Cobb Douglas production function to simulate diminishing returns of capital. This means that as the amount of capital per worker increases, the production increases but at a decreasing rate.

In order for the capital per worker, k, to increase, and therefore increase income per worker, y, the investment through savings, s, needs to be higher than the effect of depreciation and population growth on capital per worker. This can be shown in a graph.



The steady state growth in this Solow model is the intersection between these two lines. The point is where investment exactly equals depreciation and population growth. If the economy had less capital per worker than k*, the production would be so high that the savings would increase k up until k*. If we were at a k>k*, the diminishing returns would lead production to be lower. Savings would not replace the depreciated capital. In this steady state, total capital

and total income increases, but not income and capital per capita. If we wanted an increase in growth, the parameters would need to change, for example we could increase savings leading to a shift upwards into a new steady state. The increase in s would not lead to long term growth in the economy but only up to a new steady state.

The standard Solow model predicts conditional convergence. This means that, irrespective of initial level of income per capita, all countries with the same key parameters, savings, population growth etc, will end up at the level of income per capita. This idea can be explained generally by the fact that developing countries can take advantage of earlier technological progress which has become cheaper and more accessible. Richer countries on the other hand need to make more expensive investments in R&D to innovate and develop further. In this model the conclusion comes from the assumption of diminishing returns of capital and constant human capital. Richer countries which start at a higher level of capital per worker will grow more slowly than countries with lower levels of capital, thus allowing them to catch up. Rate of growth is inversely related to initial levels of income per capita.

This conclusion changes if we include the possibility of accumulated not only physical but also human capital. We assume that countries can choose to invest in human capital at a rate q like for physical. Holding the other form of capital constant, we have diminishing returns. This can be explained by the fact that smart workers can develop better technology increasing productivity, but if they are restricted by the amount of capital, the productivity increase will be decreasing. The same goes the other way, better machines do not need as intelligent workers to operate them, but to progress further, the human capital sets a limit on progress.

There is however a ratio of growth for each type at which there is a constant return to investment. Due to the fact that both production factors are complementing each other and have individual diminishing returns, this will lead to the optimal investment decision being at rates which stay at this ratio.

This leads to new conclusions for the Solow model. It no longer clearly predicts convergence. By including the possibility to invest in human capital, we eliminate the diminishing returns that let the poorer countries catch up. If we assume that the developing countries have low human capital and higher physical capital, we see that the initial investment in human capital will lead to a large growth rate for the country. However, once the ratio is reached, the country will grow at the same rate as the developed country. The model also explains the low return on physical capital. It might be due to the low levels of human capital that hinder the full utilization of physical capital.

The model further complicates the issue by showing us to adverse effects on developed countries. Given that they have higher human capital, the rate of return to physical capital should be higher than for poor countries. This might even lead to divergence. The other effect is that as the country gets close to the "limit" of technology, further advancements are more expensive. This could indicate convergence. These two forces make the conclusion from the model difficult to decide.

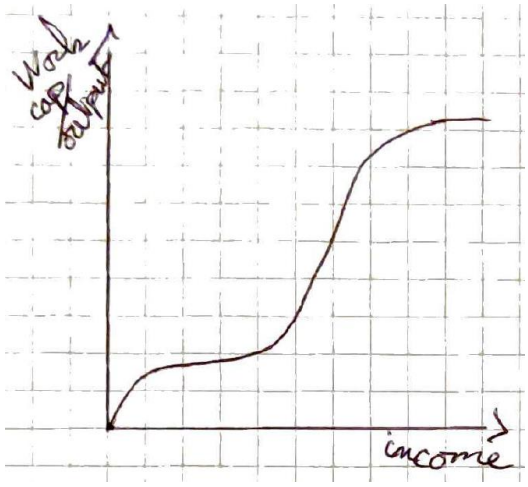
Question 3 (25%) Labour

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?

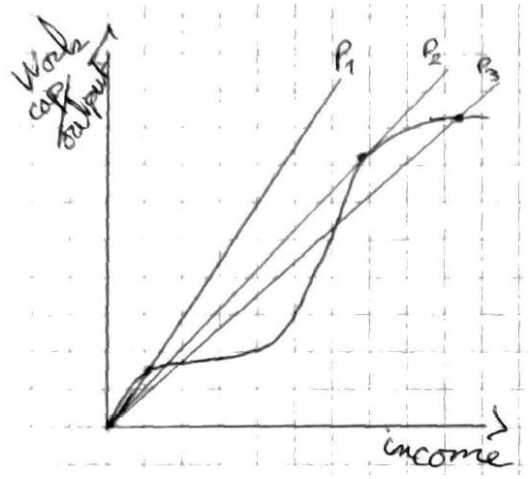
In standard labour market models, we assume that if demand for labour rises there will be a supply to meet it. A requirement for this is that all workers have enough work capacity to work at the given demand. This might be a fair assumption in developed countries, but in developing countries, where undernutrition is a problem, the assumption is unreasonable.

Using a nutrition model, we can explain that work capacity and labour supply in developing countries. We start by assuming that at low levels of income, income equals nutrition. This seems fair when we think about the share of production that is subsistence farming. A person needs enough nutrition to fulfill bodily functions before the "surplus" can go towards increased work capacity. As income (nutrition) goes up from 0, the increase in work capacity is minimal, because the basic needs are not met yet. After these are fulfilled, the extra income

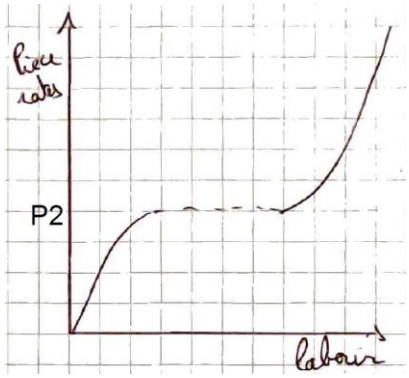
leads to a large increase in work capacity. As the income rises more, the increase in work capacity slows down, still increasing but at a decreasing rate. This gives us the work capacity line, a worker with a given level of nutrition will have the associated output.



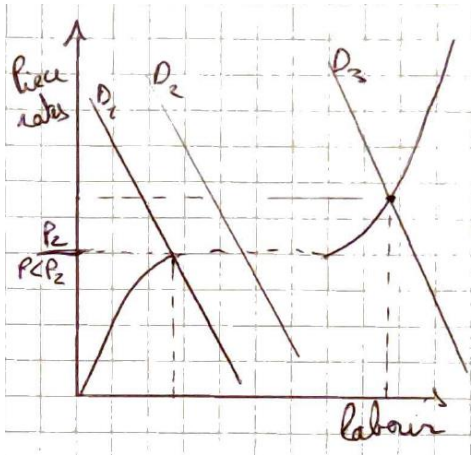
By introducing a wage into the model, we can find the workers supply curve. We assume that workers are paid a wage based on their output, we call this a piece rate. We plot in three levels of piece rates, P1, P2 and P3. The steeper the incline, the lower the wage.



At P1, the worker will only be able to earn enough to have a low output. The piece rate is not enough to increase work capacity substantially. At P2, the worker will barely earn enough to have an increase output with correct nutrition. At P3, the worker will have a high output. We see that at any piece rate below P1, the worker will not be able to increase their output due to malnutrition. This gives us their supply curve.



We see that until the wage is higher than P2, the output will be low. Let's insert som demand curves to analyze the dynamics of the model.



The D1 equilibrium is low wage, low output. Even if demand rose to D2, the workers would be too malnourished to increase their output, the equilibrium would be the same as in D1. The demand would need to increase to D3 for the workers to get enough nutrition to provide a high work capacity.

This shows the potential for a poverty trap due to undernutrition. If the demand does not rise to D3, the workers will stay undernourished and unable to provide a high output, leading no growth. The large increase necessary could call for the need of a big push policy to increase investments in workers. This could take the form of wage subsidies for firms to hire undernourished workers.

This model still ignores the fact that workers who have a history of undernutrition will not time before they can achieve high output, even with high wages. We would need a system for long term nutrition thereby increasing their work capacity. A solution might be long term contracts.

They are an agreement between firms and workers that the firms will provide nutrition until the workers have a high enough work capacity to produce at which time they will work for the firm. One problem is that if there is a possibility for workers to take advantage by earning the high income while not working and leaving to other firms to work when their output has increased, the firms are not likely to want to invest in these workers.

This risk is affected by the possibility for the worker to get a new contract. If the worker has a high chance of getting a new permanent contract, the risk of leaving is low. This can be affected by the reputation. If the area is small and anonymity is low, farm owners can communicate and cause problems for shirkers. This leads to problems for the workers in small rural settings, not a problem in urban sectors. As development increases, mobility and possibility of finding work increases as well.

Another issue is that in the agricultural sector, there are uncertainties connected to the production each high season. Since they do not know how much labour they will need, they might not want to have to pay many workers during the low season.

These are reasons that, even though permanent contracts can be beneficial for both firms and workers, they might not be implemented. There is the that a worker might not stay to repay the investment and, if the production is agricultural, the uncertainty connected to the size of the harvest and therefore the optimal demand for labour.

Question 4. (25%) 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 labour important and why does the process of migration to urban areas eventually slow down?

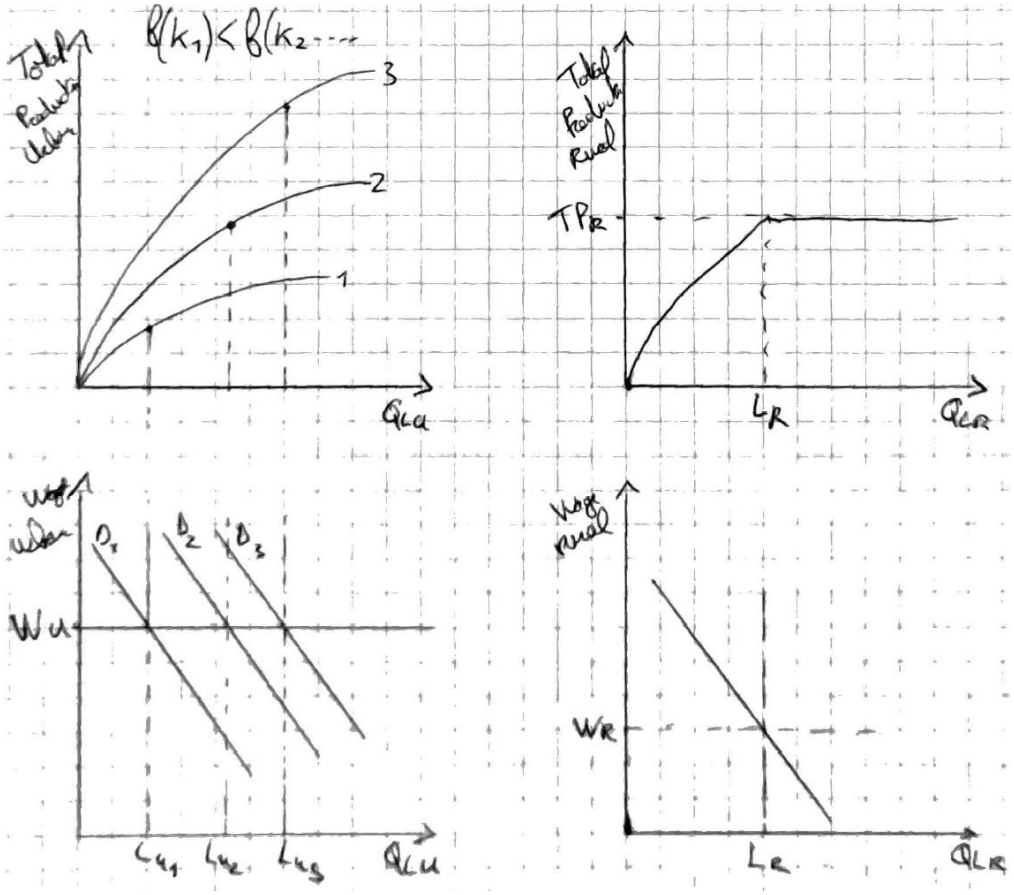
As the question states the importance of surplus labour I will use the Lewis model to answer. All countries observe a tendency of urbanization. For developing countries, it is a vital part of the growth process to increase the productivity of labour. The Lewis model is an early attempt to explain the transition for a rural to an urban based economy.

Them model is based on a few assumptions. The economy has two sector, one agricultural sector with low productivity and surplus population and an urban sector with high

productivity and no unemployment or informal sector. Surplus population means that if number of farmworkers were to drop, the total production would not change. This is based on the idea that labour has diminishing returns. If the amount of labour decreases, the productivity of the remaining workers would increase, and total production would stay the same.

The wage in the urban sector is assumed to be fixed, higher than rural wages and unchanged by the number of workers in the urban sector. There are zero profits in the rural sector and no possibility for capital investment. In the urban sector the profits are reinvested and lead to a higher productivity. We assume that the capital will not replace the need for labour.

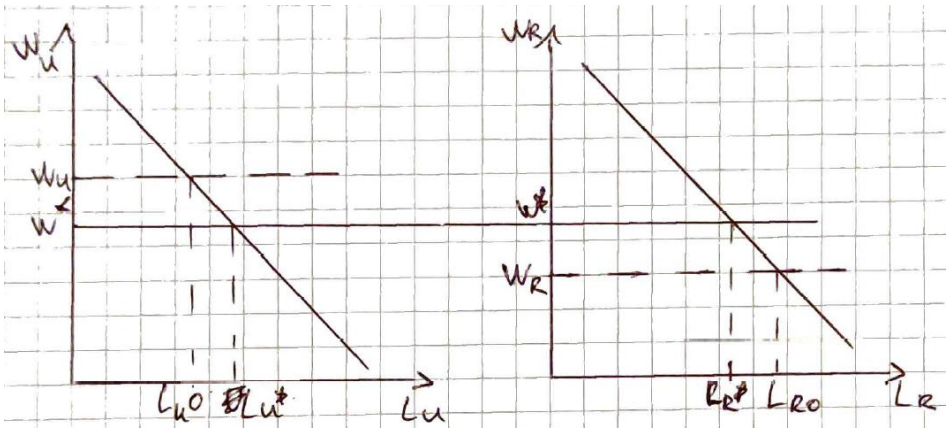
These assumptions lead to the urban sector being able to employ as many rural workers as they want without changing neither the urban wages nor the rural production. The transition can be modelled like this:



As demand for labour in the urban sector increases, migration to cities will increase. This will lead to an increase in manufacturing production. The profits will be reinvested in capital that increase the marginal returns to labour, further increasing the manufacturing production and profits. The capital increase will lead to shifts in production curves from 1 through 3. As the

marginal returns to labour increase, so will the demand for labour. The urban demand shifts from D1 through D3. This positive shifts in production are possible because of labour surplus in the rural sector.

In the long run, when the rural sector no longer has surplus population, a further increase in labour demand will require an increase in rural wages to compensate. The urban sector will need to lower their wages in response to employ the necessary workers, thus reducing the urbanization rate. This dynamic leads to an eventual equalization of wages across sectors and stabilization of population shares.

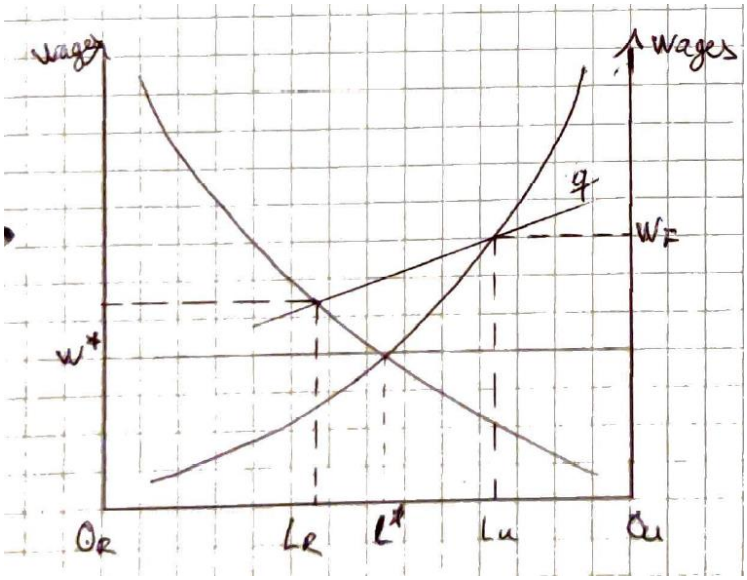


The conclusions of the Lewis model are based on many strong assumptions that may not be reasonable. First, we lack empirical confirmation that the rural sector has surplus labour. Without this, the model would not work as demand from the urban sector would lead to immediate increase in rural wages thus hindering the transition. Secondly, the assumption that urban sector has no unemployment is unreasonable. Unemployment and informal production tend to be a large share of the urban sector. The migration between sector is based on a certain wage that is actually uncertain. Lastly, we could assume that capital accumulation could lead to investment in urban sector that reduce the demand for labour, not increase it.

The Harris-Todaro model is another model that attempts to map the urbanization process. The model tries to deal with the aforementioned assumptions. It allows for unemployment or informal work. The workers will now migrate based on the expected wages in the urban sector, either a high, fixed formal wage that is difficult to acquire or an above subsistence informal wage

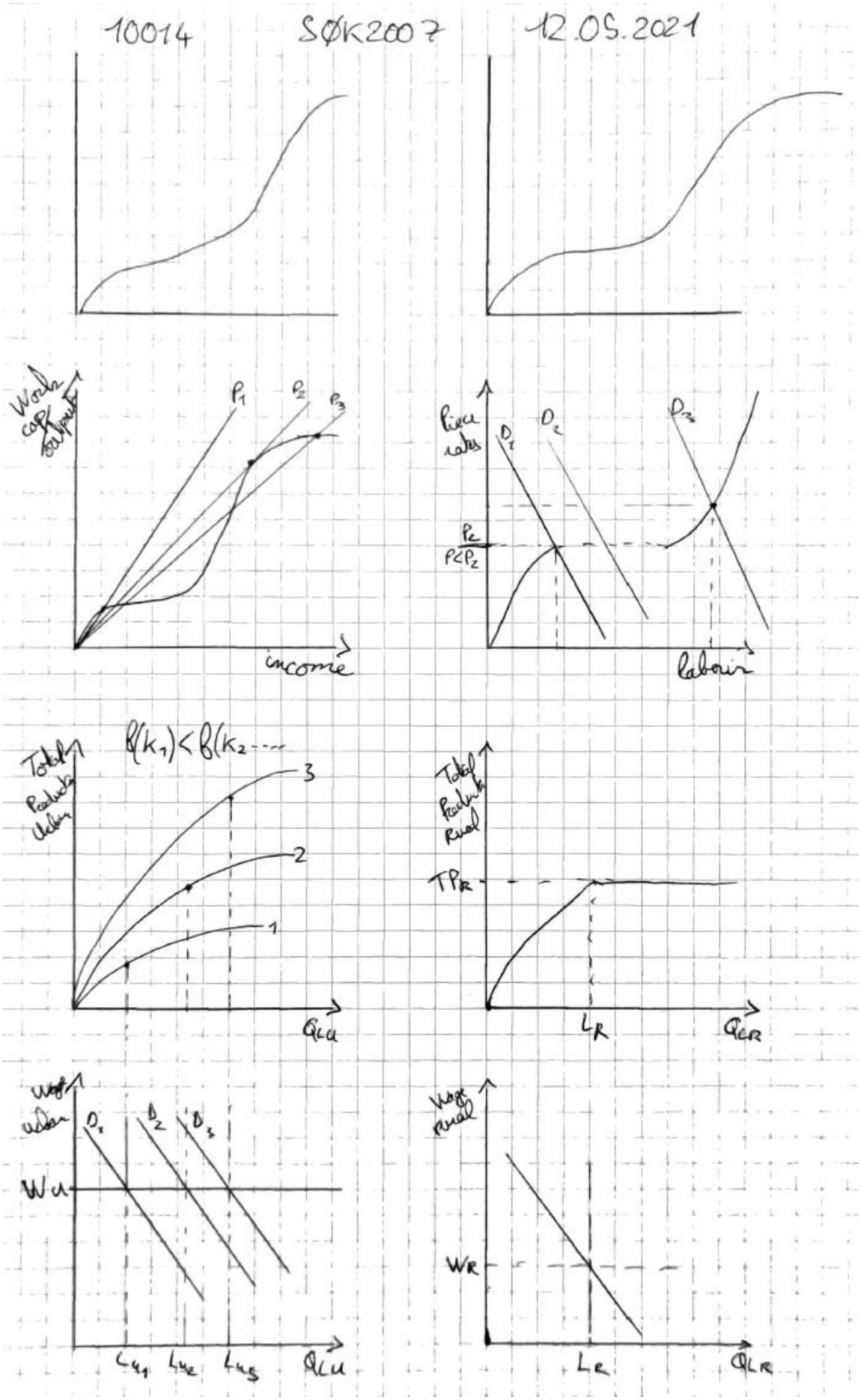
$$\frac{L_F}{L_F + L_I} \cdot W_F + \frac{L_I}{L_F + L_I} \cdot W_I = W_A$$

This will give us the following model.



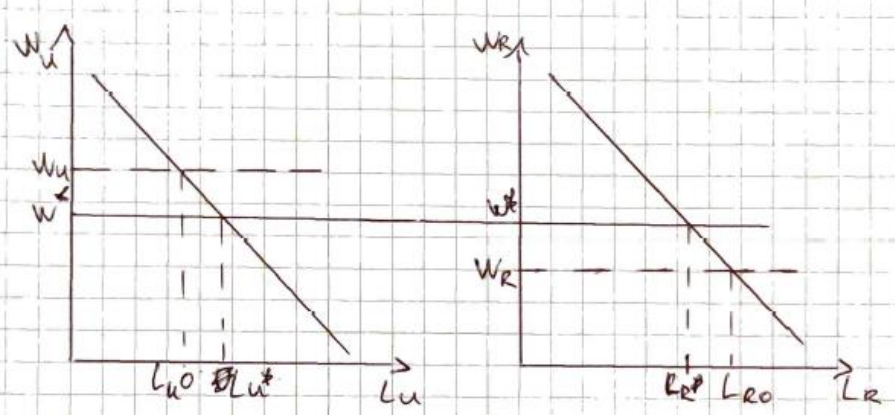
The Lewis prediction is stabilization at L* and w*. The Harris-Todaro model concludes that migration will stabilize when the expected wage in the urban sector equals the wage in the rural sector. The gap between formal and rural employment is the informal sector. This conclusion seems more reasonable than the Lewis model due to the uncertainty of getting a formal job in the urban sector. This risk is not included in the Lewis model.

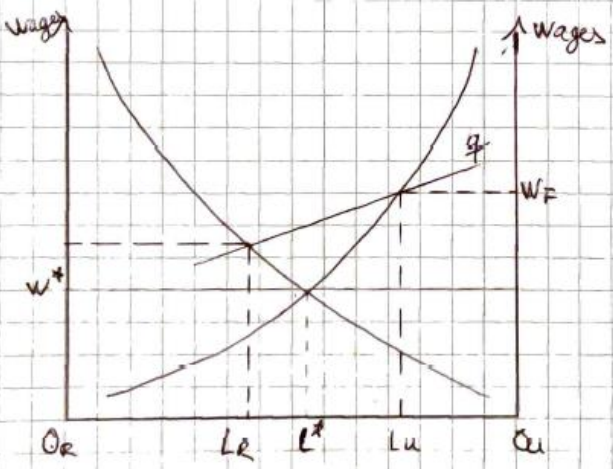
It is probably unnecessary, but we are apparently required to mark each figure with our candidate number and such. So instead, here are the pages of figures I used.

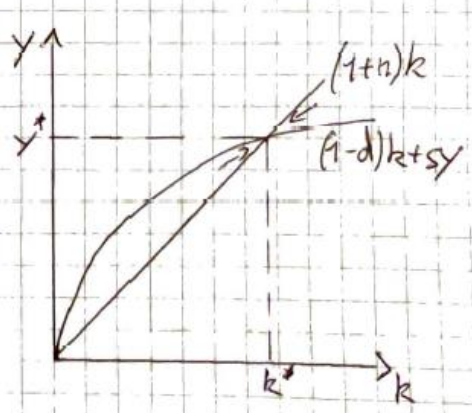

10014
SØK2007
12.05.2021
Work cap. output
P1
P2
P3
income
Price rates
D1
D2
D3
P2
P<P2
labour
Total Product Units
P(K1)<P(K2---
3
2
1
QLa
Total Product Real
TPR
LR
QLR
Wage units
D1
D2
D3
Wa
La1
La2
La3
QLa
Wage Real
WR
LR
QLR

(11) $r = h^*/k^*$ $r = \frac{g}{s}$

(8) $\frac{L_F}{L_F + L_I} \cdot W_F + \frac{L_I}{L_F + L_I} \cdot W_I = W_A$







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