ASSIGNMENT I: THE HANC MODEL

1 Question 1

In this question, we are asked to define the stationary equilibrium for the HANC model in the assignment.

The stationary equilibrium of this HANC model is defined as the following:

- The quantities capital, K_{ss} and labor, L_{ss}.
- The price on capital, r_{ss}, and the price on labor, w_{ss}.
- The distribution of households over idiosyncratic states, D_{ss}.
- The households are heterogenous in terms of time-varying stochastic productivity, z_t, end of period assets, a_{t-1}, household's dis-utility of labor, φ_i, and time-invariant productivity, ζ_i)
- Policy functions, which are a^*_{ss}, l^*_{ss} and c^*_{ss}.

These are the things which the model consists of. Then the solution that defines the stationary equilibrium full fills:

- First a^*_{ss}, l^*_{ss} and $c_{^*_{ss}}$ is found such as the household's optimization problem is solved.
- The firms maximizes profit and thereby chooses K_{ss} and L_{ss}. Profit is thus zero by assumption in equilibrium.
- Then the markets clear.
  - The labor market clears: $L_t = L^{hh}_t$
  - The labor market clears: $B_T + K_t = A^{hh}_T$
  - The labor market clears: $Y_t = C^{hh}_T + I_t + G_t$

2 Question 2

In this question we are asked to solve for the stationary equilibrium.

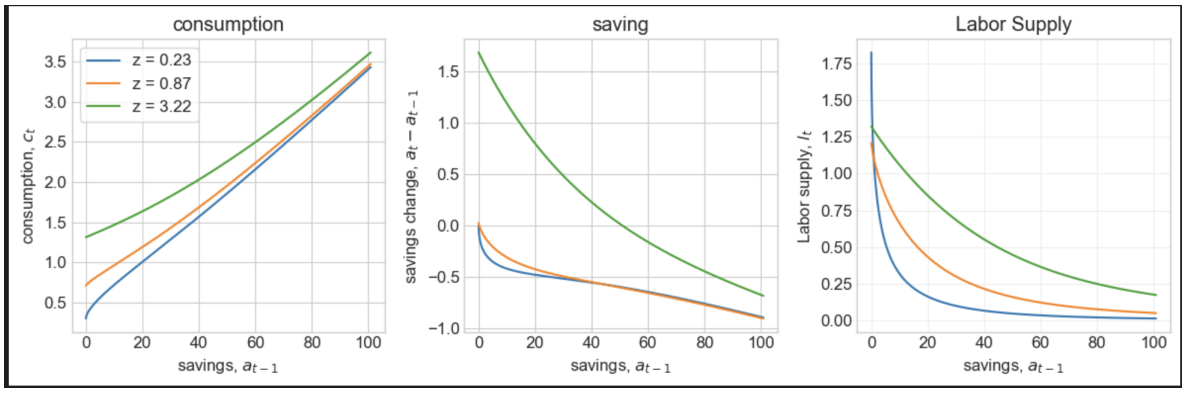
The aggregate quantities and prices a shown in the table below:

Table 2.1: Aggregate Quantities and Prices in the Stationary Equilibrium

Y_{ss}	1.458
K_{ss}	3.419
L_{ss}	1.012
B_{ss}	0.627
C_{ss}	0.816
I_{ss}	0.342
r_{ss}	0.028
w_{ss}	1.009

The household's behavior in the form of labor supply, consumption and savings, is shown in the figure below.

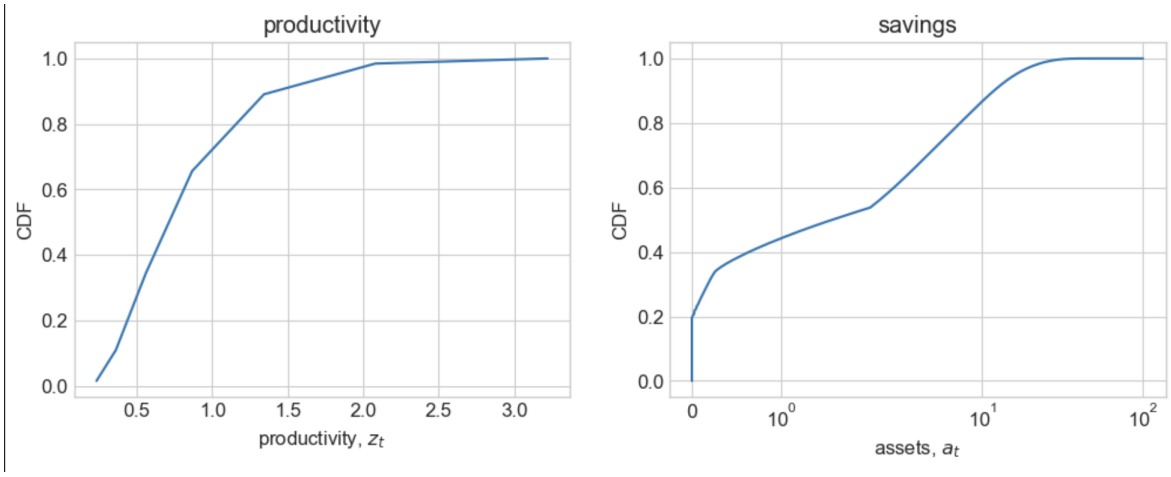
Figure 2.1: Illustration of Household Behavior



In the figure above, the labor supply, consumption and savings as a function of assets in the last period for different productivity levels are shown. We see, that for higher levels of productivity the consumption and labor supply is also higher. For all levels of savings in the last period, it account that the more productive a household is, the more the household can consume and supply its labor.

The distribution of households is shown below:

Figure 2.2: Distribution of Households



The figures above shown the CDF-functions for productivity and savings.

The CDF-function for productivity has a steep upwards slope for low productivity, and a more flat upwards slope for higher productivity levels. It further shown, that no agents has a productivity above 2.1. This shows, that 70 per cent of agents in the economy has a productivity below 1. The remaining 30 per cent of the agents in the economy has a productivity between 1 and 2.1.

The CDF-function for assets is almost shaped like a S. 20 per cent of the households have no savings, 30 per cent of the households have relatively few assets, and 50 per cent are distributed to have relatively more assets. In the upper 50 per cent of the distribution, the slope of the CDF-function is steeper compared to the CDF function below 50 per cent and above 20 per cent.

3 Question 3

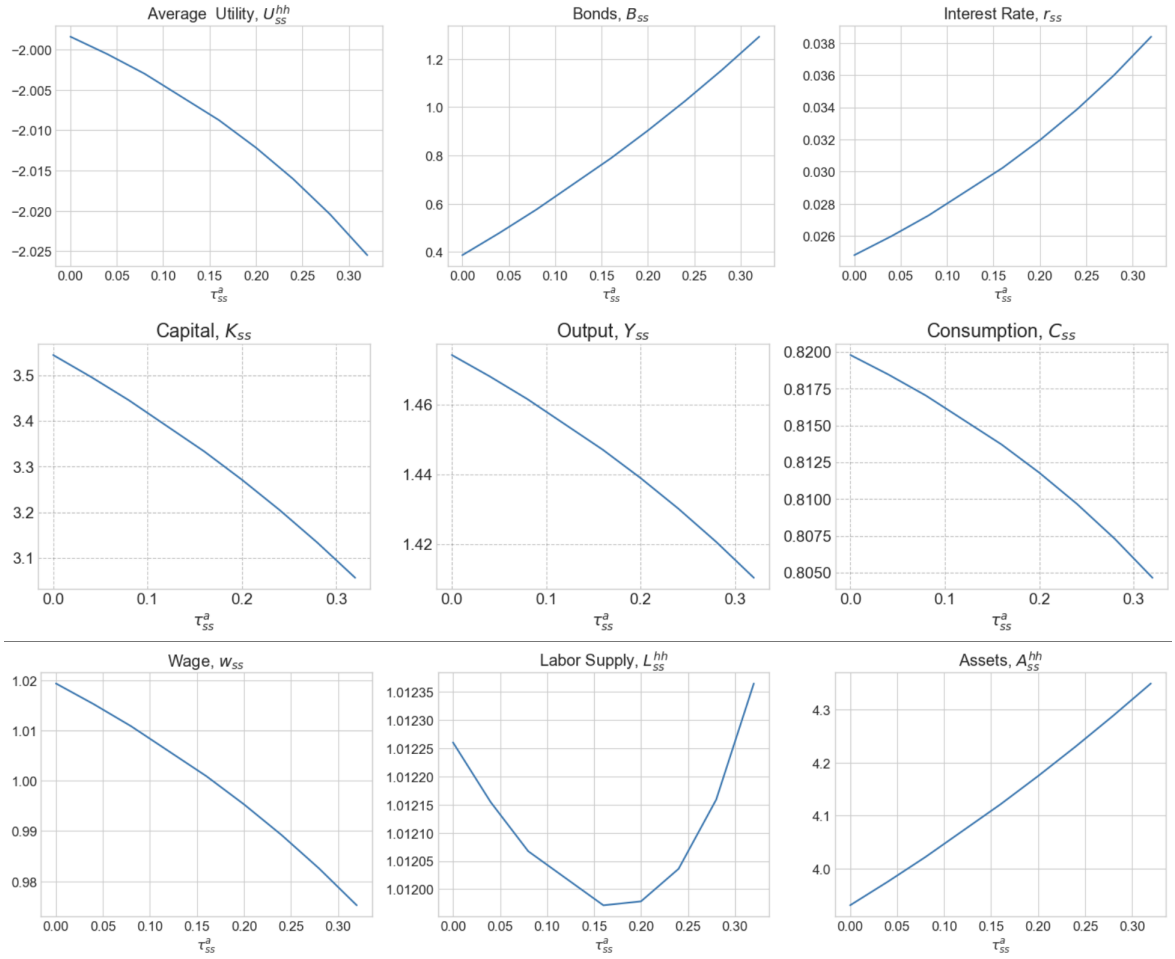
In this question, we are asked to illustrate how changes in the tax rates affect the stationary equilibrium.

To do so the prices and quantities in the Stationary Equilibrium are shown as a function of respectively tax on assets, τ_a, and tax on labor, τ_l.

The figures below show quantities in the Stationary Equilibrium as a function of tax

on assets, τ_a.

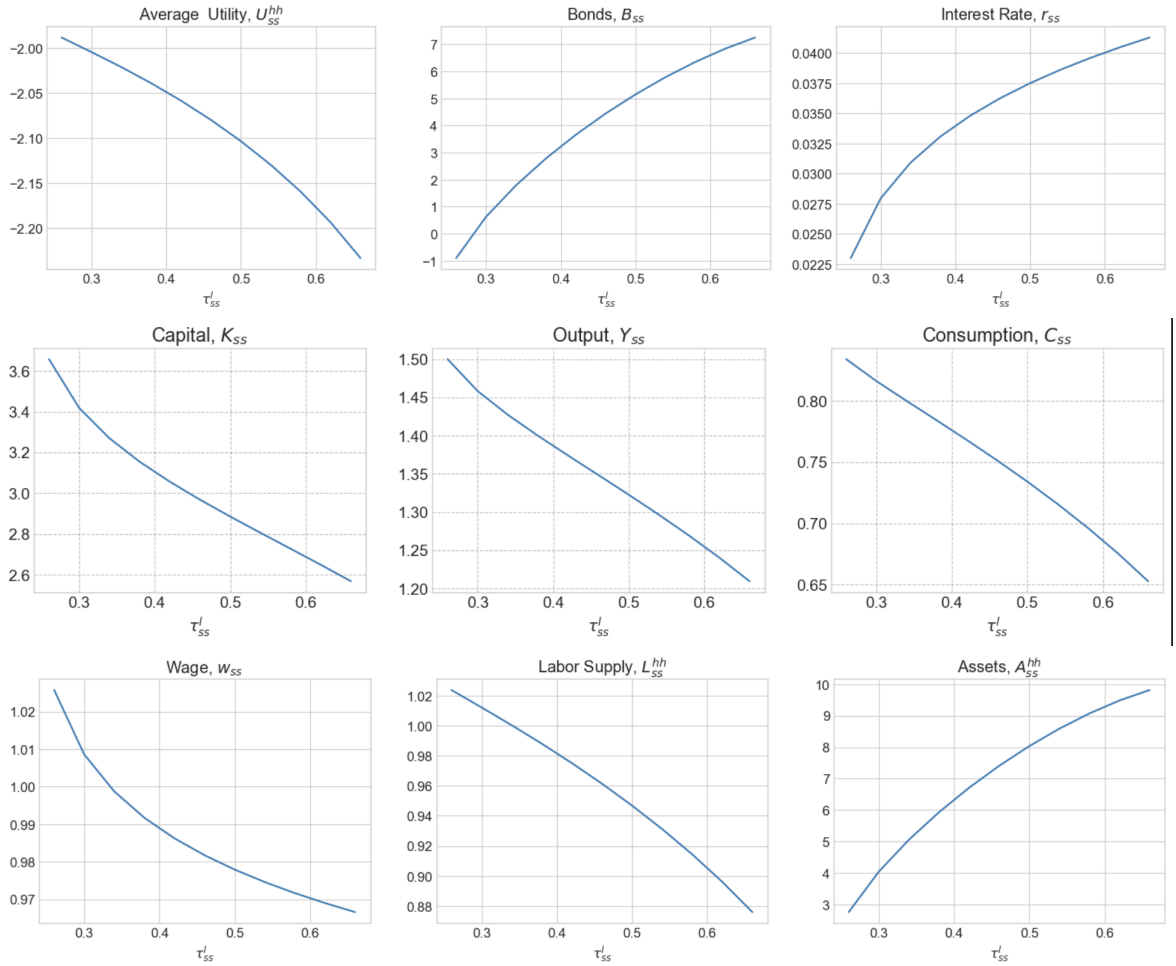
Figure 3.1: Changes in taxes on assets for prices and quantities in the Stationary Equilibrium



The figures above show quantities and prices in the Stationary Equilibrium as a function of tax on assets, τ_a. When tax on assets increases, the rate of return increases as well, making it more attractive to save why assets increase. To obey the Government's budget constraint, issued bonds increases as well.

The figures below show quantities in the Stationary Equilibrium as a function of tax on labor, τ_l.

Figure 3.2: Changes in taxes on labor for prices and quantities in the Stationary Equilibrium



The figures above shows that all prices and quantities despite the household's labor supply have the same slope when they are a function of τ_l as when they are a function of τ_a.

The mechanism are therefore very similar. But now when τ_l increases the labor supply is monotonically decreasing. That is because the household's insensitive to work decreases as the disposable income decreases. Some household's opportunity cost is higher, and therefore they choose to supply less labor.

4 Question 4

In this question, we are asked to discuss the social optimal level of taxation.

If we look at the average household utility as a social welfare criterion, we see from question 3, that the average utility is decreasing in τ_a and τ_l. The optimal tax on assets and labor, is thereby zero if we take average utility as the welfare criterion.

If thus the taxes are zero, there would not be a public sector, and thereby there would not be a bond market. It will thereby not be possible for the households to buy bonds. This could thus still be social optimal as the taxes are not re-distributed to the households. By only collecting taxes and not re-distribute the taxes, it correspond to taking money out of the economy, which entails in a lower average utility.

Another measure to look at could be the gini-coefficient or another inequality measure, to see how the income and assets are distributed. Right now, it is the average utility which is shown, but looking at the distribution of income, or the skewness in utility could also be relevant to look at when discussing the social optimal level of taxation.

5 Question 5

In this question we are asked to suggest and implement an extension which improves the tax system.

The current model collects taxes which are not redistributed to the households. My idea for an extension which improves the tax system is a transfer from the government to the households. Therefore, a χ is added to the code. I have chosen to assign χ a quite small value, but the extension still still change the steady state values. The steady state values are reported in the table below.

Table 5.1: Aggregate Quantities and Prices in the Stationary Equilibrium

	Baseline model	Model with government transfer
Y_{ss}	1.458	1.475
K_{ss}	3.419	3.585
L_{ss}	1.012	1.008
B_{ss}	0.627	-1.030
C_{ss}	0.816	0.817
I_{ss}	0.342	0.359
r_{ss}	0.028	0.024
w_{ss}	1.009	1.024

The table above show that when adding a transfer the production, capital, wage, and consumption increase, and bonds, interest rate and labor decrease. Further, if we use the average household utility as a social welfare criterion, we see the transfer increases when adding the transfer, suggesting that the extension improves the tax system.