# Assignment 2

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## 0.1 Question a

In the scenario where the government does not intervene (i.e., $\chi$, $G$, $L^G = 0$), the model predicts an expected discounted utility of $-2500000039.9042172$. This substantial negative value is indicative of the aggregated utility of all households under a government-absent regime. In economic models, utility often encapsulates the welfare or satisfaction derived by agents, in this case, the households. A lower utility value, particularly one this negative, implies a less favorable outcome for households, possibly indicating unmet needs or preferences that government interventions (such as public goods provision or redistribution policies) could fulfill. The result underscores the potential importance of government activities in enhancing household welfare, especially in scenarios where public goods and services are vital.

## 0.2 Question b

Optimization using Scipy's minimize function reveals a nuanced picture of the government's role in maximizing expected discounted utility. For a scenario with no transfers ($\chi_t = 0$), the optimal government labor, $L_t^G$, is specified to be 0.2751. Correspondingly, the optimal government spending, $G_t$, given the hint that $G_t = \Gamma^G L_t^G$, is also 0.2751. This leads to a ratio of government spending to the total output, $G_t/Y_t$, of 0.3074.

This ratio of 30.74% suggests a balanced role for government intervention in the model's economy. It suggests that, while government intervention remains crucial for public goods provision and services, the model's economy also significantly relies on market mechanisms for achieving optimal welfare.

## 0.3 Question c

I try to extend the optimal welfare policies by further investigating the impact of nonzero transfers ($\chi_t \neq 0$). Two distinct designs were examined: one with a small negative transfer ($\chi_t = -0.001$) and another with a small positive transfer ($\chi_t = 0.001$).

In the scenario with a small negative transfer, the model finds the optimal values for government labor, $L_t^G$,

and government spending, $G_t$, to be 0.2747. This leads to a total expected utility of $-172.5756$ and a $G_t/Y_t$ ratio of 0.3071. Conversely, when a small positive transfer is introduced, the optimal $L_t^G$ and $G_t$ are slightly higher, at 0.2754, with the total expected utility being marginally lower at $-173.2193$. The $G_t/Y_t$ ratio in this case is 0.3100.

These findings suggest that the model's optimal welfare policies are somewhat sensitive to the direction of transfers. The slightly higher $G_t/Y_t$ ratio and lower total utility with positive transfers imply that such transfers necessitate a marginally greater level of government intervention, perhaps to balance the additional direct financial support to households. On the other hand, the introduction of small negative transfers appears to require a slightly lower level of government activity to achieve optimal welfare.

It's important to note that the differences in utility and $G_t/Y_t$ ratios between the two scenarios are relatively small, indicating that the model's outcomes are robust to minor variations in transfer policies. However, these subtle differences underscore the nuanced role that transfers play in the overall economic equilibrium and household welfare. The optimal approach between positive and negative transfers would depend on the broader goals of the welfare policy, including considerations of equity and efficiency, and the specific characteristics of the model's economy.

## 0.4 Question d

In examining the effects of an increased total factor productivity (TFP, with $\Gamma_Y = 1.1$), the model provides insightful findings on how optimal welfare policies adjust under enhanced economic productivity conditions. This analysis examines different transfer scenarios ($\chi_t$) to understand their implications in a higher TFP environment.

For the scenario with a small negative transfer ($\chi_t = -0.001$), the model identifies optimal government labor ($L_t^G$) and spending ($G_t$) at 0.2815, leading to a total expected utility of $-162.0525$ and a $G_t/Y_t$ ratio of 0.2944. In the absence of transfers ($\chi_t = 0$), the optimal levels of $L_t^G$ and $G_t$ slightly decrease to 0.2810, with a total expected utility closely resembling the negative transfer scenario at $-162.2559$ and a $G_t/Y_t$ ratio of 0.2943. Introducing a small positive transfer ($\chi_t = 0.001$) results in further marginal reductions in the optimal government labor and spending to 0.2806, while the total expected utility slightly diminishes to $-162.4615$, and the $G_t/Y_t$ ratio remains constant at 0.2943.

These observations underscore several vital aspects of the model's response to increased TFP:

- The rise in TFP leads to a slight decrease in the optimal levels of government labor and spending across all transfer scenarios. This reduction reflects a more efficient allocation of government resources within a more productive economic framework.
- Despite the economy's increased productivity, the proportion of government spending in relation to

the total output ($G_t/Y_t$) experiences a small decline. This trend indicates that the government's role, although slightly reduced, remains significant in ensuring optimal welfare.

- Across all scenarios, the total expected utility is less negative with increased TFP, suggesting an overall increase in household welfare. This improvement aligns with the expectations that higher economic productivity should translate into better welfare outcomes.

Overall, the analysis under increased TFP conditions reveals the adaptability of optimal welfare policies to changes in economic productivity. While the government's intervention adjusts to maintain optimal welfare levels, the overall increase in productivity clearly contributes to improved welfare outcomes, as evidenced by the higher expected discounted utility levels across the board.

## 0.5 Question e

We see with the TFP increase, it's clear that the government's role in direct economic intervention may need recalibration. The new productivity means that the economy can achieve better welfare outcomes with potentially less government spending and labor involvement. This doesn't reduce the government's role but suggests a more efficient application of its resources. Thus, during the transition, a gradual reduction in $G_t$ and $L_t^G$ might be needed, ensuring that the public sector complements rather than overshadows the more productive private sector.

The adjustment of transfer policies ($\chi_t$) also becomes a nuanced affair in this new context. While the previous analysis showed that the direction of transfers (positive or negative) slightly influenced welfare outcomes, this effect might be more pronounced with higher TFP. The government, therefore, faces the challenge of fine-tuning its transfer mechanisms, balancing direct support to households with the broader economic goal of maintaining an efficient and equitable system.

The temporal aspect of these policy changes is crucial. An abrupt transition could lead to market disruptions or welfare losses, suggesting a more phased approach might be beneficial. This would allow economic agents to adapt smoothly to the new policy environment and the heightened productivity levels.

In essence, the transition from the standard to the enhanced TFP scenario calls for a thoughtful reorientation of government policies. While maintaining a significant presence, the government's strategy should lean towards optimizing resource use in a more productive economic environment. The focus should be on ensuring that public sector activities are streamlined and effectively complement the dynamism of the private sector, thereby maximizing overall welfare in the new productivity context.