Preliminaries:

The purpose of this assignment is to permit you to systematically explore the empirical relevance of the relationship between a Competitive Market Equilibrium and Pareto Optimality. The CGE model represents a simple Arrow-Debreu economy, and the assignment begins with this economy in “first best” position. You will subsequently explore the implications of breaking each of the conditions for Pareto Optimality via imposition of a series of taxes. Finally, we will consider the situation in which we start from a policy-distorted state of the world, and explore potential “second best” interactions between new and existing taxes.

The structure of the economy used in this assignment is drawn from the example offered by Kym Anderson in his EDCC article (see Table 1). He considers two economies: one a prototype poor economy with most of its labor force still in labor-intensive agriculture, and one a rich economy, with little of its labor force left in a highly commercialized agriculture sector. For this assignment, we will work with the poor economy. For the sake of simplicity, we have aggregated the three households into a single, representative household. This makes welfare analysis particularly simple. The model could be readily extended to include the three household groups in his paper.

The behavioral equations in this economy will be familiar from the earlier modules. Consumer demand is based on a simple, Cobb-Douglas utility function, and producer behavior is based on profit maximization subject to a nested CES production function. Agriculture and manufactures are treated as tradable commodities for which the economy faces exogenously fixed world prices. Services are treated as a non-tradable, as are the endowment commodities: labor, farm capital (including land), and non-farm capital. Before conducting any analysis, you will need to program in the equilibrium conditions for this economy. These include: market clearing conditions, zero profit conditions, balance of payments equilibrium, as well as a key formula for income determination.
Analysis Starting from a Distortion-Free Economy

1. Program in the missing equations and verify that you get the following results when you introduce a labor tax in agriculture of 5%: \( tfe(\text{"labor"}, \text{"agric"}) = 5; \) (using the data from the undistorted economy (basedata.har).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>EV</td>
<td>-0.07</td>
</tr>
<tr>
<td>y</td>
<td>-0.07</td>
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<tr>
<td>u</td>
<td>-0.07</td>
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2. Beginning from the undistorted data base (basedata.har) for this economy, introduce five different distortions, one-at-a-time, and examine their effects. The five policy shocks to be administered are as follows:

   a) Five percent tax on labor use in the agricultural sector:
      \( tfe(\text{"labor"}, \text{"agric"}) = 5; \)
   
   b) Five percent tax on labor use in all sectors:
      \( tfe(\text{"labor"}, \text{SECTOR}) = 5; \)
   
   c) Five percent tax on agricultural output:
      \( to(\text{"agric"}) = -5; \)
   
   d) Five percent tax on consumption of agricultural goods:
      \( tp(\text{"labor"}, \text{"agric"}) = 5; \)
   
   e) Five percent tax on exports of agricultural goods:
      \( tm(\text{"agric"}) = -5; \)

Please fill in the following table, then discuss your findings, one shock at a time. Given the theme of this assignment, you should relate your discussion to the topic of Pareto Optimality in each case. Are the conditions for Pareto Optimality violated? If so, which ones? Feel free to accompany your discussion with graphical analysis.
### Analysis Starting from a Distortion-Laden Economy

3. Beginning from the distorted data base for this economy (distortdata.har), introduce the consumption tax on agriculture products: $tp(\text{"labor"}, \text{"agric"}) = 5$. Use the welfare decomposition code to explain the change in aggregate welfare stemming from this intervention.

4. Beginning from this distorted data base, shock the world price of agricultural products by 10%; $pw(\text{"agric"}) = 10$. Use the welfare decomposition code to explain the change in aggregate welfare stemming from the exogenous shock to the small, open economy.