Modelling Gender aspects of Policy Reforms in Bangladesh: A Study in a Sequential Dynamic CGE Framework

Selim Raihan*
Sayma H. Bidisha*
Muhammad Jami Husain

Abstract

The purpose of this proposed research is to explore the gender aspects of the welfare and poverty implications of policy reforms in Bangladesh in a sequential dynamic computational general equilibrium (CGE) framework. Our present research uses the most updated SAM of Bangladesh and is the first attempt to build a gendered sequential dynamic CGE model for the Bangladesh economy. We develop the ‘home production’ version of gendered CGE model for the Bangladesh economy. Our research tries to understand how gender interests are affected by greater exposure to trade and other policy reforms. We also explore the short-run and long-run impacts of policy reforms in the labour market and in the household in a gendered framework. The main objectives of this proposed research are to examine the impact of: (1) Domestic trade liberalisation in Bangladesh; (2) phasing-out of Multi-fibre Agreement (MFA) on textile and garments; and (3) WTO Doha agreements on global trade reforms. To assess the effects of policy reforms at the sectoral level and poverty in a gendered framework in Bangladesh we will build a gendered social accounting matrix (SAM) for the year 2000, and use it in a sequential dynamic computable general equilibrium framework. We follow the representative household approach and use a household survey to estimate poverty effects of different policy shocks. The possible simulations are: (1) Full elimination of existing domestic tariffs, (2) phasing-out of MFA, and (3) WTO Doha global trade reforms. Simulation outcomes will be reported under price, volumes, income, consumption, welfare changes and poverty incidence within a gendered framework.

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1. Introduction

The purpose of this proposed research is to explore the welfare and poverty implications of policy reforms in Bangladesh in a gendered sequential dynamic computational general equilibrium (CGE) framework. In standard economic analysis, the gender aspect of policy reforms is ignored or not taken into consideration. However, there are ample evidences that the impact of any policy reform is not uniform across men and women, even within the same household. Our present research is the first attempt to build a gendered sequential dynamic CGE model for the Bangladesh economy.

The organisation of the proposal is as follows. In the next section we present a brief discussion on the Bangladesh economy. After that, we discuss the objectives, expected value-addition by this research, methodology and the simulation possibilities.

2. Structure of the Bangladesh Economy

2.1. Changes in the Economic Structure during the 1980s and 1990s

Over the last two decades Bangladesh has undergone major changes in the structure of its economy, trade, poverty and inequality. The changes in the economic structure are reported in table 1.

Table 1: Changes in the Economic Structure during 1980-2000

<table>
<thead>
<tr>
<th>Sectors</th>
<th>Share in GDP at constant 1995-96 prices (in percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>33.2</td>
</tr>
<tr>
<td>Industry</td>
<td>17.1</td>
</tr>
<tr>
<td>Services</td>
<td>49.7</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>


Table 1 suggests that during the last two decades the structure of the economy changed significantly as the share of agriculture in GDP declined to 25.6 percent by 2000 from 33.2 percent in 1980. The fall in the share of agriculture has been accompanied by the rise in the share of industry, which increased from 17.1 percent in 1980 to 25.7 percent in
2000, thanks to the remarkable performance of manufacturing exports during the 1990s. The share of service remained stable at around 49 percent throughout the whole period.

Table 2: Structural Change and Growth in Merchandise Trade

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Exports (as % of GDP)</td>
<td>5.3</td>
<td>5.6</td>
<td>6.1</td>
<td>10.9</td>
<td>14.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Imports (as % of GDP)</td>
<td>14.5</td>
<td>13.2</td>
<td>13.5</td>
<td>17.3</td>
<td>19.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Openness (Exports + Imports as % of GDP)</td>
<td>19.8</td>
<td>18.8</td>
<td>19.6</td>
<td>28.2</td>
<td>33.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Export Volume</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.0</td>
<td>14.9</td>
</tr>
<tr>
<td>Export Value</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7.8</td>
<td>11.3</td>
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<tr>
<td>Import Volume</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-4.3</td>
<td>20.5</td>
</tr>
<tr>
<td>Import Value</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.6</td>
<td>10.7</td>
</tr>
</tbody>
</table>


Table 2 suggests that during the 1990s both exports and imports registered high growth rate compared to the period of 1980s. On average, export volume and export value increased by 14.9 percent and 11.3 percent respectively during the 1990s. Whereas, during the 1980s the average annual growth rate of export volume and export value were only 1 percent and 7.8 percent respectively. In the case of imports, the average annual growth rate of volume was negative during the 1980s, which registered substantially high average growth rate (20.5 percent) during the 1990s. Also, the average growth rate of import value also increased significantly, from 3.6 percent in the 1980s to 10.7 percent in the 1990s. Openness of the economy (expressed as exports plus imports as percent of GDP) increased to 33.2 percent in 2000 from around 20 percent in the early 1980s.

2.2. Basic Structure of the Bangladesh Economy in year 2000

Table 3 summarises the basic structure of the Bangladesh economy in year 2000, as understood from the 2000 SAM of Bangladesh (Annabi et al., 2004). Import duty rates ranges from as low as 1 percent to as high as 55.2 percent. The highest import duty is imposed on the petroleum sector, whereas the lowest is for the Ready-made Garment sector. The sectoral import penetration ratio (ratio of imports to domestic demand) is highest for Ready-made Garment (44 percent), followed by Petroleum (43 percent). Sectors with the highest shares in total imports are Machinery (32.8 percent), followed by Petroleum (12 percent). The sectoral export-orientation ratio (exports as a share of output)
is the highest for Ready-made Garment (92 percent), followed by Leather (31 percent). Apart from these two sectors, export-orientation is quite low in other sectors. Ready-made Garment exports account for 67 percent of total exports. Together the Service and Construction sectors account for 60 percent of total value-added in the economy. The contribution of agriculture and manufacturing sectors in total value-added are 17 percent and 23 percent respectively. The share of value-added in production is the highest for the Service sector (67.5 percent), followed by Construction (56.1 percent) and Cereal Crop (48.4 percent). The corresponding figure for Ready-made Garment is 32.8 percent.

**Table 3: Basic Structure of the Bangladesh Economy in year 2000**

<table>
<thead>
<tr>
<th>Sector</th>
<th>Tariff rates</th>
<th>Import Penetration ratio</th>
<th>Import share</th>
<th>Export Orientation ratio</th>
<th>Export share</th>
<th>Value added share</th>
<th>Share of value added in production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereal Crop</td>
<td>17.9</td>
<td>2.1</td>
<td>1.3</td>
<td>0.0</td>
<td>0.0</td>
<td>6.5</td>
<td>48.4</td>
</tr>
<tr>
<td>Commercial Crop</td>
<td>7.1</td>
<td>15.4</td>
<td>8.5</td>
<td>3.5</td>
<td>2.7</td>
<td>5.0</td>
<td>45.0</td>
</tr>
<tr>
<td>Livestock-Poultry</td>
<td>23.9</td>
<td>3.8</td>
<td>2.1</td>
<td>4.9</td>
<td>4.3</td>
<td>3.6</td>
<td>28.7</td>
</tr>
<tr>
<td>Forestry</td>
<td>22.5</td>
<td>0.1</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>1.5</td>
<td>52.5</td>
</tr>
<tr>
<td>Rice-Ata Milling</td>
<td>3.6</td>
<td>1.8</td>
<td>1.8</td>
<td>0.0</td>
<td>0.0</td>
<td>3.2</td>
<td>15.0</td>
</tr>
<tr>
<td>Other Food</td>
<td>12.7</td>
<td>19.7</td>
<td>11.9</td>
<td>1.3</td>
<td>1.0</td>
<td>2.2</td>
<td>19.0</td>
</tr>
<tr>
<td>Leather</td>
<td>20.2</td>
<td>0.6</td>
<td>0.1</td>
<td>30.9</td>
<td>6.7</td>
<td>0.6</td>
<td>22.0</td>
</tr>
<tr>
<td>Clothing</td>
<td>10.6</td>
<td>8.1</td>
<td>3.4</td>
<td>5.5</td>
<td>3.5</td>
<td>2.8</td>
<td>29.8</td>
</tr>
<tr>
<td>Ready-made Garment</td>
<td>1.0</td>
<td>44.1</td>
<td>2.9</td>
<td>91.9</td>
<td>67.0</td>
<td>3.4</td>
<td>32.8</td>
</tr>
<tr>
<td>Chemical-Fertiliser</td>
<td>20.8</td>
<td>29.4</td>
<td>9.9</td>
<td>4.2</td>
<td>1.6</td>
<td>1.7</td>
<td>28.4</td>
</tr>
<tr>
<td>Machinery</td>
<td>16.8</td>
<td>38.7</td>
<td>32.8</td>
<td>0.1</td>
<td>0.1</td>
<td>4.8</td>
<td>37.9</td>
</tr>
<tr>
<td>Petroleum</td>
<td>55.2</td>
<td>42.9</td>
<td>12.0</td>
<td>1.3</td>
<td>0.3</td>
<td>0.7</td>
<td>6.6</td>
</tr>
<tr>
<td>Other Industries</td>
<td>27.3</td>
<td>20.5</td>
<td>10.4</td>
<td>4.0</td>
<td>2.5</td>
<td>3.3</td>
<td>30.7</td>
</tr>
<tr>
<td>Construction</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>9.3</td>
<td>56.1</td>
</tr>
<tr>
<td>Services</td>
<td>10.3</td>
<td>0.7</td>
<td>2.4</td>
<td>1.9</td>
<td>9.8</td>
<td>50.7</td>
<td>67.5</td>
</tr>
</tbody>
</table>


### 2.3 Poverty and Inequality in Bangladesh

Table 4 presents the intertemporal poverty and inequality in the Bangladesh economy. This table provides information on the head-count index of poverty for both the rural and urban areas. Also, Gini indices on the basis of consumption are given to show the changes over time in inequality in the rural and urban areas. Table 4 suggests that during 1992-2000, the national head-count ratio of poverty declined by 9 percent, indicating a reduction in poverty by an annual average of 1 percent in this period as against an annual average 0.23 percent decline during 1984-1989. This suggests that the fall in the national
poverty rate is higher during the 1990s compared to that in the 1980s. It is also observed that both urban and rural poverty declined during the 1990s, although, the incidence of rural poverty remained higher than that of urban poverty. It also appears that over the entire period, since the early 1980s, the improvement in the poverty incidence is rather slow with substantial variations in different sub-periods and between rural and urban areas. With respect to the inequality it is evident that the Gini index of consumption expenditure remained largely unchanged till 1992 for both rural and urban areas. But, the urban Gini index for consumption expenditure rose from 32 percent in 1992 to 36.6 percent in 2000. On the other hand, for the rural areas it rose from 25.5 percent to 29.7 percent during the same period.

Table 4: Poverty and Inequality in Bangladesh

<table>
<thead>
<tr>
<th>Year</th>
<th>Exchange Rate (1 US$ = Taka)</th>
<th>Poverty line Income (Tk/Person/Month)</th>
<th>Mean Consumption (Tk/Person/Month)</th>
<th>Head Count Ratio (%)</th>
<th>Gini index (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>1984</td>
<td>24.94</td>
<td>301.72</td>
<td>396.53</td>
<td>50.2</td>
</tr>
<tr>
<td></td>
<td>1989</td>
<td>32.14</td>
<td>453.65</td>
<td>695.19</td>
<td>43.9</td>
</tr>
<tr>
<td></td>
<td>1992</td>
<td>38.20</td>
<td>534.99</td>
<td>817.12</td>
<td>44.9</td>
</tr>
<tr>
<td></td>
<td>1996</td>
<td>40.90</td>
<td>650.45</td>
<td>1,372.47</td>
<td>29.4</td>
</tr>
<tr>
<td></td>
<td>2000</td>
<td>50.31</td>
<td>724.56</td>
<td>1,291.53</td>
<td>36.6</td>
</tr>
<tr>
<td>Rural</td>
<td>1984</td>
<td>24.94</td>
<td>268.92</td>
<td>284.84</td>
<td>59.6</td>
</tr>
<tr>
<td></td>
<td>1989</td>
<td>32.14</td>
<td>379.08</td>
<td>435.39</td>
<td>59.2</td>
</tr>
<tr>
<td></td>
<td>1992</td>
<td>38.20</td>
<td>469.13</td>
<td>509.67</td>
<td>61.2</td>
</tr>
<tr>
<td></td>
<td>1996</td>
<td>40.90</td>
<td>541.77</td>
<td>661.47</td>
<td>55.2</td>
</tr>
<tr>
<td></td>
<td>2000</td>
<td>50.31</td>
<td>634.48</td>
<td>820.20</td>
<td>53.0</td>
</tr>
</tbody>
</table>

Memorandum Item

| National Head Count Ratio | 1984 -58.5 % and 1989 -57.1 % | (Annual reduction rate –0.23%) | 1992 -58.8 % and 2000 - 49.8 % | (Annual reduction rate –1%) |

Note: The figures are based on the Household Expenditure Surveys of the Bangladesh Bureau of Statistics (BBS). The poor have been estimated using the cost of basic needs (CBN) method and are taken as those living below the poverty line which corresponds to an intake of 2,122 kcal/person/day and a non-food allowance corresponding to the non-food expenditure among household whose food expenditure equals the food poverty line.


2.4. Gender in the Bangladesh Economy

Table 5 suggests that in Bangladesh, agriculture sector accounts for the largest share in total employment, with 49.2 percent of labour (45.6 percent of female labour and 50 percent of male labour) in 1999-2000 is employed in this sector. In the urban area, men
are mostly employed in the service sectors (particularly trade services and transport and storage activity), while women are more employed in the manufacturing sector (which is predominantly the ready-made garment sector) and in the community and personal services. In the rural area, agriculture is the primary source of employment for both men and women. The second important activity for men and women in the rural area is the trade services and the manufacturing respectively.

Table 5: Employed Persons by Sex, Locality, and Industry in 1999-2000 (in percent)

<table>
<thead>
<tr>
<th>Major Activity</th>
<th>Urban Male</th>
<th>Urban Female</th>
<th>Urban All</th>
<th>Rural Male</th>
<th>Rural Female</th>
<th>Rural All</th>
<th>Bangladesh Male</th>
<th>Bangladesh Female</th>
<th>Bangladesh All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture, Forestry</td>
<td>10.4</td>
<td>15.0</td>
<td>11.5</td>
<td>61.1</td>
<td>55.9</td>
<td>60.1</td>
<td>50.2</td>
<td>45.6</td>
<td>49.2</td>
</tr>
<tr>
<td>Fishing</td>
<td>1.5</td>
<td>0.0</td>
<td>1.1</td>
<td>1.6</td>
<td>1.7</td>
<td>1.7</td>
<td>1.6</td>
<td>1.3</td>
<td>1.5</td>
</tr>
<tr>
<td>Mining and Quarrying</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.4</td>
<td>0.0</td>
<td>0.3</td>
<td>0.3</td>
<td>0.0</td>
<td>0.3</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>13.4</td>
<td>25.0</td>
<td>16.1</td>
<td>5.7</td>
<td>15.3</td>
<td>7.6</td>
<td>7.4</td>
<td>17.7</td>
<td>9.5</td>
</tr>
<tr>
<td>Electricity, Water and Gas</td>
<td>1.5</td>
<td>0.0</td>
<td>1.1</td>
<td>0.4</td>
<td>0.0</td>
<td>0.3</td>
<td>0.6</td>
<td>0.0</td>
<td>0.5</td>
</tr>
<tr>
<td>Construction</td>
<td>4.5</td>
<td>5.0</td>
<td>4.6</td>
<td>2.5</td>
<td>1.7</td>
<td>2.3</td>
<td>2.9</td>
<td>2.5</td>
<td>2.8</td>
</tr>
<tr>
<td>Trade Services</td>
<td>26.9</td>
<td>10.0</td>
<td>23.0</td>
<td>13.9</td>
<td>6.8</td>
<td>12.5</td>
<td>16.7</td>
<td>7.6</td>
<td>14.9</td>
</tr>
<tr>
<td>Hotel</td>
<td>3.0</td>
<td>0.0</td>
<td>2.3</td>
<td>1.2</td>
<td>0.0</td>
<td>1.0</td>
<td>1.6</td>
<td>0.0</td>
<td>1.3</td>
</tr>
<tr>
<td>Transport and Storage</td>
<td>16.4</td>
<td>0.0</td>
<td>12.6</td>
<td>5.7</td>
<td>0.0</td>
<td>4.6</td>
<td>8.0</td>
<td>0.0</td>
<td>6.4</td>
</tr>
<tr>
<td>Finance, Business, Services</td>
<td>1.5</td>
<td>0.0</td>
<td>1.1</td>
<td>0.4</td>
<td>0.0</td>
<td>0.3</td>
<td>0.6</td>
<td>0.0</td>
<td>0.5</td>
</tr>
<tr>
<td>Real Estate</td>
<td>1.5</td>
<td>0.0</td>
<td>1.1</td>
<td>0.4</td>
<td>0.0</td>
<td>0.3</td>
<td>0.6</td>
<td>0.0</td>
<td>0.5</td>
</tr>
<tr>
<td>Public Admin</td>
<td>6.0</td>
<td>5.0</td>
<td>5.7</td>
<td>1.2</td>
<td>0.0</td>
<td>1.0</td>
<td>2.3</td>
<td>1.3</td>
<td>2.1</td>
</tr>
<tr>
<td>Education</td>
<td>3.0</td>
<td>5.0</td>
<td>3.4</td>
<td>2.5</td>
<td>1.7</td>
<td>2.3</td>
<td>2.6</td>
<td>2.5</td>
<td>2.6</td>
</tr>
<tr>
<td>Health &amp; Social Workers</td>
<td>1.5</td>
<td>0.0</td>
<td>1.1</td>
<td>0.4</td>
<td>0.0</td>
<td>0.3</td>
<td>0.6</td>
<td>0.0</td>
<td>0.5</td>
</tr>
<tr>
<td>Community, Personal Services</td>
<td>9.0</td>
<td>35.0</td>
<td>14.9</td>
<td>2.5</td>
<td>16.9</td>
<td>5.3</td>
<td>3.9</td>
<td>21.5</td>
<td>7.4</td>
</tr>
<tr>
<td>All Sector</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>


Table 6 indicates that women represent one fourth of all total labour force in Bangladesh. In the urban area agriculture, manufacturing, education, construction and community and personal services are the female labour-intensive activities. On the other hand, in the rural area agriculture, manufacturing, fishing and community and personal services are the female labour-intensive activities.
### Table 6: Disaggregating Employment by Gender in 1999-2000 (in percent)

<table>
<thead>
<tr>
<th>Major Activity</th>
<th>Urban Male</th>
<th>Urban Female</th>
<th>Urban All</th>
<th>Rural Male</th>
<th>Rural Female</th>
<th>Rural All</th>
<th>Bangladesh Male</th>
<th>Bangladesh Female</th>
<th>Bangladesh All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture, Forestry</td>
<td>70.0</td>
<td>30.0</td>
<td>100.0</td>
<td>81.9</td>
<td>18.1</td>
<td>100.0</td>
<td>81.3</td>
<td>18.8</td>
<td>100.0</td>
</tr>
<tr>
<td>Fishing</td>
<td>100.0</td>
<td>0.0</td>
<td>100.0</td>
<td>80.0</td>
<td>20.0</td>
<td>100.0</td>
<td>83.3</td>
<td>16.7</td>
<td>100.0</td>
</tr>
<tr>
<td>Mining and Quarrying</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>100.0</td>
<td>0.0</td>
<td>100.0</td>
<td>100.0</td>
<td>0.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>64.3</td>
<td>35.7</td>
<td>100.0</td>
<td>60.9</td>
<td>39.1</td>
<td>100.0</td>
<td>62.2</td>
<td>37.8</td>
<td>100.0</td>
</tr>
<tr>
<td>Electricity, Water and Gas</td>
<td>100.0</td>
<td>0.0</td>
<td>100.0</td>
<td>100.0</td>
<td>0.0</td>
<td>100.0</td>
<td>100.0</td>
<td>0.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Construction</td>
<td>75.0</td>
<td>25.0</td>
<td>100.0</td>
<td>85.7</td>
<td>14.3</td>
<td>100.0</td>
<td>81.8</td>
<td>18.2</td>
<td>100.0</td>
</tr>
<tr>
<td>Trade Services</td>
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<td>10.0</td>
<td>100.0</td>
<td>89.5</td>
<td>10.5</td>
<td>100.0</td>
<td>89.7</td>
<td>10.3</td>
<td>100.0</td>
</tr>
<tr>
<td>Hotel</td>
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<td>100.0</td>
<td>100.0</td>
<td>0.0</td>
<td>100.0</td>
<td>100.0</td>
<td>0.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Transport and Storage</td>
<td>100.0</td>
<td>0.0</td>
<td>100.0</td>
<td>100.0</td>
<td>0.0</td>
<td>100.0</td>
<td>100.0</td>
<td>0.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Finance, Business, Services</td>
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<td>0.0</td>
<td>100.0</td>
<td>100.0</td>
<td>0.0</td>
<td>100.0</td>
<td>100.0</td>
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<td>100.0</td>
</tr>
<tr>
<td>Real Estate</td>
<td>100.0</td>
<td>0.0</td>
<td>100.0</td>
<td>100.0</td>
<td>0.0</td>
<td>100.0</td>
<td>100.0</td>
<td>0.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Public Admin</td>
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<td>100.0</td>
<td>100.0</td>
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<td>100.0</td>
<td>87.5</td>
<td>12.5</td>
<td>100.0</td>
</tr>
<tr>
<td>Education</td>
<td>66.7</td>
<td>33.3</td>
<td>100.0</td>
<td>85.7</td>
<td>14.3</td>
<td>100.0</td>
<td>80.0</td>
<td>20.0</td>
<td>100.0</td>
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<tr>
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<td>100.0</td>
<td>100.0</td>
<td>0.0</td>
<td>100.0</td>
<td>100.0</td>
<td>0.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Community, Personal Services</td>
<td>46.2</td>
<td>53.8</td>
<td>100.0</td>
<td>37.5</td>
<td>62.5</td>
<td>100.0</td>
<td>41.4</td>
<td>58.6</td>
<td>100.0</td>
</tr>
<tr>
<td>All Sectors</td>
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<td>23.0</td>
<td>100.0</td>
<td>80.53</td>
<td>19.47</td>
<td>100.0</td>
<td>79.75</td>
<td>20.25</td>
<td>100.0</td>
</tr>
</tbody>
</table>


### 3. Research Objectives

The general objective of this research is to explore how gender interests are affected by greater exposure to trade and other policy reforms in the short and long run. In particular, this research aims to investigate the impacts of policy reforms in the labour market and in the household within a gendered framework. The main objectives of this proposed research are to explore the gender-impacts of the following policy reforms:

- Domestic trade liberalisation in Bangladesh.
- Phasing-out of Multi-fibre Agreement (MFA) on textile and garments.
- WTO Doha agreements on domestic tariff cut, withdrawal of subsidies on agriculture in the developed countries, etc.
4. The Issues and the Expected Value-addition by the Proposed Research

A number of studies have looked into the aspect of increased women participation in the labour market as a result of the expansion in the export-oriented activities in the economy (Elson and Pearson, 1981; Standing, 1989; Wood, 1991; Cagatay and Ozler, 1995; Joekes, 1995 and 1999; and Ozler, 2000 and 2001). In Bangladesh, with the expansion of the ready-made garments sector, there has been a significant increase in the women participation in the labour force, as employment in this sector is predominantly women. However, the magnitudes of the changes in women participation in the labour market and that of women welfare are not always in the same direction. There are concerns that, even in situations with increase in household income as a result of increase in women participation in the export-oriented industries, women welfare may not necessarily be improved. The reason is that, even though there has been an increase in household income, it may be accompanied by decreasing home food production, with a negative impact on the satisfaction of basic food needs in poor households. It is also important to note that the impacts of any policy reform are not even uniform across women; there are winners and losers among women, which is directly a function of factor endowments, particularly labour skills, sectoral factor intensities and mobility (Fofana, et al, 2003).

Fofana et al. (2003) identify three variants of gender models in the CGE analysis, the simple models of disaggregating sectoral labour by sex, the models of gender leisure and endogenous labour supply, and the models of domestic work (home production). The authors argue that the last variant of gender models is superior to the first two variants. Fofana et al (2003) also argue that the expansion of women participation in the labour market is not necessarily synonymous to enhanced negotiation power of women within the household. Because, it may constitute for them a burden if there is not a similar reduction of their domestic work. It is, therefore, very important to account for gender domestic production and leisure time, otherwise it will bias the analysis of the impacts of any policy reforms on welfare of men and women in less developed countries. The authors further argue that, though it is easy to disaggregate the time spent on market work and household work, but it is not easy to split the remaining time between the minimum requirement time necessary for survival (sleeping, eating, hygiene) and the “extraleisure” (sport, reading, community meeting…), required for model calibration. In contrast to some of the ‘home production’ version of gendered CGE studies (such as Fontana and
Wood, 2000) the authors suggest an alternative calibration procedure to avoid these data requirements.

In line with Fofana et al. (2003) we propose to develop a gendered model of ‘home production’ in the context of Bangladesh economy. Our research aims to generate value-additions in the following major areas:

1. Very few studies have, so far, addressed the gender aspects of policy reforms within a CGE framework in the context of Bangladesh. The studies by Fontana and Wood (2000), and Fontana (2001) are the notable tasks. On the basis of 1993-94 input-output model of Bangladesh these studies develop a gendered SAM of Bangladesh for 1993-94. In our research we use the most recent, i.e., the 1999-2000 input-output model to develop a gendered SAM for Bangladesh for the year 2000. The use of a more recent input-output table helps in a better understanding of the impacts of policy simulations corresponding to more recent phenomenon, such as the MFA phase-out in the global textile and garment trade or the implementation of the WTO Doha trade agenda.

2. The procedure adopted by Fontana and Wood (2000) to add estimates of ‘social reproduction’ (household work) and leisure to the SAM require data about which ‘perfect’ information is not available. Therefore, we use a microeconomic model and alternative calibration procedures, as suggested by Fofana et al. (2003), to avoid arbitrariness.

3. Another major point of departure from the aforementioned studies on Bangladesh is that, contrary to these studies which are based on comparative static CGE models, our study intends to develop the first gendered dynamic CGE model for Bangladesh. The major disadvantage of the static models is that they fail to account for growth effects that make them inadequate for long-run analysis of the poverty and welfare impacts of policy reforms. They exclude accumulation effects and do not allow the study of the transition path of the economy where short-run policy impacts are likely to be different from those of the long-run. On the other hand, our proposed gendered sequential dynamic CGE model of Bangladesh will be capable of capturing the long-run effects of the policy reforms.
5. Policy Relevance

This proposed study has the potentials of significant policy relevance. Whereas standard CGE models do not make any distinction in policy implications with respect to the gender aspect, our gendered CGE model is likely to exert different policy implications for men and women with respect to various policy reforms in the economy. Moreover, since our model is dynamic in nature, it will help in understanding the differences in the short run and long run policy implications.

6. Methodology

To assess the effects of policy reforms at the sectoral level and poverty in a gendered framework in Bangladesh we need to build a gendered social accounting matrix (SAM) for the year 2000, and use it in a sequential dynamic computable general equilibrium framework. We will, however, start with a comparative static model and then incorporate dynamics in the model. In this way we will be able to make a static vs. dynamic comparison of the simulation outcomes. We follow the representative household approach and use a household survey to estimate poverty effects of different policy shocks. In the following sections we describe briefly the model and the data used.

6.1. Model Features

In the proposed study we develop a sequential dynamic CGE model based on the one used in Annabi et al (2004). The list of equations and variables of the dynamic model used in Annabi et al. (2004) is presented in Annex-1. A sequential dynamic model is basically a series of static CGE models that are linked between periods by exogenous and endogenous variables updating procedures. Capital stock is updated endogenously with a capital accumulation equation. Below we present a brief description of the static and dynamic aspects of the model used in Annabi et al. (2004) and the required modifications of the model for the purpose of our proposed research.

*Static module*

**Firms.** In each sector there is a representative firm. A nested structure for production is adopted. Sectoral output is a *Leontief* function of value added and total intermediate
consumption. Value added is in turn represented by a CES function of capital and composite labour.

**Households.** Household demand is represented by a linear expenditure system (LES) derived from the maximisation of a *Stone–Geary* utility function. Minimal consumption levels are calibrated using guess-estimates of the income elasticity and the *Frisch* parameters. Household saving is a fixed proportion of the total disposal income.

**Foreign Trade.** Imperfect substitution between foreign and domestic goods is assumed, which is captured by the standard *Armington* assumption with a constant elasticity of substitution function (CES) between imports and domestic goods. On the supply side, constant elasticity of transformation (CET) between exports and domestic sales is assumed. Furthermore, a finite elasticity export demand function is incorporated that expresses the limited power of the local producers in the world market.

**Government.** The government receives direct tax revenue from households and firms and indirect tax revenue on domestic and imported goods. Its expenditure is allocated between the consumption of goods and services (including public wages) and transfers. The model accounts for indirect or direct tax compensation in the case of a tariff cut.

**Equilibrium.** General equilibrium is defined by the equality (in each period) between supply and demand of goods and factors and the investment-saving identity. The nominal exchange rate is the numéraire in each period.

**Dynamic module**

**Capital accumulation.** In every period the capital stock is updated with a capital accumulation equation. It is assumed implicitly that the stocks are measured at the beginning of the period and that the flows are measured at the end of the period.

**Investment demand.** We consider investment by sector of destination rather than investment by origin (product). The capital accumulation rate (ratio of investment to capital stock) is increasing with respect to the ratio of the rate of return to capital and its user cost. By introducing investment by destination, we respect the equality condition with total investment by origin in the SAM. Besides, investment by destination is used to calibrate the sectoral capital stock in the base run.
**Labor supply growth.** In the dynamic model of Annbi *et al.* (2004) total labour supply increases at the exogenous rate that is simultaneously the population growth rate and the labour force growth rate. However, most gendered CGE models have endogenous labour supply (leisure demand). Indeed, the labour market entry/exit of women and men, and the related wage changes, are the key aspects to be studied in a gendered CGE model. Therefore, in our proposed research we consider the total maximum time available (to be divided between domestic work, leisure and market labour activities) increases at an exogenous rate. On the other hand, the minimal level of consumption within the LES function also increases (as do other nominal variables, like transfers) at the same rate.

The exogenous dynamic updating of the model includes nominal variable (that are indexed), government savings and the current account balance. The equilibrium between total savings and total investment is reached by means of an adjustment variable introduced in the investment demand function. In the baseline all the variables are increasing, in level, at the same rate and the prices remain constant. This method is used to facilitate welfare and poverty analysis since all prices remain constant along the business as usual (BaU) path.

**Introducing gender aspects and gender-dynamics**

It can, however, be mentioned that the version of dynamic CGE model applied in Annabi *et al.* (2004) does not include gender aspects. In line with Fofana *et al.* (2003) we incorporate the ‘home production’ version of gender aspects in our dynamic model. We disaggregate male and female labour and allow them to be imperfect substitutes in sectoral production. Household supplies of male and female labour are endogenously determined by the household. In this context, total labour time is divided into three categories: market work, leisure and domestic work. The assumptions to develop a ‘home production’ version of gender model include the followings:

- Male and female non-market labour time (leisure and domestic work) are imperfect substitutes in the household utility function.
- Leisure and domestic work time, which are distinguished for each household member (men and women), are imperfectly substitutes.
- Market and home goods are imperfect substitutes in the household utility function.
- Home goods are produced using only labour (male and female) and do not require intermediate inputs or capital.
- Time spent in various activities (leisure, home production, and market activities) is perfectly separable, i.e. the same hour cannot be used, simultaneously, in two different activities.
- In equilibrium and for each gender, the marginal utility of time is equal across different activities (leisure, home production, and market work in different sectors).

The information contained in the Household Expenditure Survey 2000 and Labour Force Survey 2000 of Bangladesh will be used to estimate the time devoted by men and women to home production. To estimate the maximum time available for men and women we follow the same procedure as have been suggested by Fontana and Wood (2000), Fontana (2001 and 2002) and Fofana et al. (2003). Generally, the data for the minimum consumption of home goods is not available. We thus, in line with Fofana et al. (2003) arbitrarily fix this value at 30 percent of total home goods consumed in the household, and test the sensitivity of the model to this parameter. An outline of the method to incorporate gender aspects in a ‘home production’ framework is briefly discussed in Annex-2.

A further important point to note here that the dynamic model suggested in our proposal so far have not considered any ‘dynamic’ aspect from the gender perspective per se. One way of introducing a dynamic aspect from the gender perspective could be by considering how gender might affect the process of human capital accumulation. It can be examined what happens to the educational composition of the female labour force over time. In the context of Bangladesh economy it can be hypothesised that the growth in female education is linked to the expansion of the ready-made garments (RMG) sector, which employs female labour force with at least some years of schooling.

6.2. The Bangladesh Social Accounting Matrix for 2000

We start with the 2000 Social Accounting Matrix (SAM) of Bangladesh used in Annabi et al. (2004). The main sources of information for the SAM are (a) 1999/2000 Input-output table prepared by Sustainable Human Development Project, Planning Commission, Government of Bangladesh; (b) Household Expenditure Survey 2000 by Bangladesh
Bureau of Statistics; (c) Labour Force Survey 2000 by Bangladesh Bureau of Statistics; and (d) National Income Estimates by Bangladesh Bureau of Statistics. Table 7 summarises the basis features of 2000 SAM of Bangladesh used in Annabi et al. (2004).

Table 7: Features of 2000 SAM of Bangladesh used in Annabi et al. (2004)

<table>
<thead>
<tr>
<th>Set</th>
<th>Description of Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Activities</strong></td>
<td></td>
</tr>
<tr>
<td>Agriculture (4)</td>
<td>Cereal Crops, Commercial Crops, Livestock-Poultry, Forestry.</td>
</tr>
<tr>
<td>Industries (9)</td>
<td>Rice and Ata Milling, Other Food, Leather products, Clothing, Ready Made Garments, Chemical-Fertilizer, Machinery, Petroleum Products, and Other Industries.</td>
</tr>
<tr>
<td>Services (2)</td>
<td>Construction, Other Services.</td>
</tr>
<tr>
<td><strong>Institutions</strong></td>
<td></td>
</tr>
<tr>
<td>Households (9)</td>
<td>Rural Agriculture: 4 categories according to land ownership: Landless, Marginal Farmer, Small Farmer, and Large Farmer.</td>
</tr>
<tr>
<td></td>
<td>Rural Non-Farmer: 1 category according to occupation</td>
</tr>
<tr>
<td></td>
<td>Urban: 4 categories according to the level of education of the household’s head: Illiterate, Low Education, Medium Education, and High Education.</td>
</tr>
<tr>
<td>Others (2)</td>
<td>Government, Rest of the World</td>
</tr>
<tr>
<td><strong>Factors of production</strong></td>
<td></td>
</tr>
<tr>
<td>Labor (2)</td>
<td>Unskilled: Class 0-IX</td>
</tr>
<tr>
<td></td>
<td>Skilled: Class X and above</td>
</tr>
<tr>
<td>Capital (2)</td>
<td>Agricultural capital</td>
</tr>
<tr>
<td></td>
<td>Non agricultural capital</td>
</tr>
</tbody>
</table>

It appears that the above description of 2000 SAM does not give any special emphasis on capturing the gender aspect of policy reforms. We propose to construct a gender-sensitive SAM of Bangladesh for 2000.

**Classification of Activities.** It is important to identify the sectors which are gender-sensitive. In this regard, keeping in mind the objectives of the research, we will employ the original 45 sector SAM of Bangladesh for 2000. The 45 sector SAM is a fairly disaggregated SAM which helps in identifying the sectors which are relatively female labour intensive.

**Labour Factor Classification.** In the SAM 2000, used in Annbi et al. (2004), the labour market is not separated into female and male labourers. Only two skilled categories of labourers are specified on the basis of level of education. However, the original 45 sector SAM of Bangladesh for 2000 includes the gendered disaggregation of labour factors.

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1 The 15 sector 2000 SAM of Bangladesh for 2000 used in Annbi et al. (2004) has been derived from the original 45 sector 2000 SAM of Bangladesh.
The original 45 sector SAM of Bangladesh for 2000 classifies labour according to the following four categories: male low skilled, male high skilled, female low skilled and female high skilled. We can, however, have more disaggregation of labour factors by considering three skill levels (low, medium and high) for both male and female.

6.3. Simulation Possibilities

Following simulations may be performed to analyse the impacts of policy reforms.

Simulation 1: The effects of complete elimination of domestic tariff.

Simulation 2: The effects of MFA phase-out. The shocks on export and import prices and on export volumes are taken from the GTAP model.

Simulation 3: The impacts of WTO Doha trade agenda. The shocks on export and import prices and on export volumes are taken from the GTAP model.

In our model we will incorporate price and volume shocks for both exports and imports from the GTAP model (which are derived from the research project of Hertel and Winters, 2005).

6.4. Analysis of Simulation Outcomes

Simulation outcomes will be reported under price, volumes, income, consumption, welfare changes and poverty incidence in a gendered framework. These are discussed below:

Tariff elimination and also the external price shocks from global trade reform affect the relative prices in the economy. The changes in relative prices influence the allocation of resources, value-added, incomes and consumption expenditures. The prices and volume effects, as well as the impact on factor movement of different policy reforms will be presented and analysed.
As result of the factorial income distribution (i.e. generated from value added) household incomes are altered due to any policy shock. Changes in the household income alter their consumption expenditure influencing welfare and poverty of the households. In this study the Equivalent Variation (EV) will be used as a measure of welfare to examine welfare impacts of simulations.

With a view to evaluate the impacts of the policy simulations on the poverty profile of the representative households we will apply Foster-Greer-Thorbecke (FGT) poverty measures (Foster, et al, 1984). The FGT indices allow us to compare three measures of poverty: head count ratio; poverty gap index and squared poverty gap index. In order to estimate these three indices a poverty line income is first defined. Poverty line income is the minimum income that is required to maintain a subsistence level of consumption. The first indicator, the head count ratio, is the proportion of population with a per capita income below the poverty line. This is the simplest measure of poverty. The second indicator, the poverty gap index, measures the depth of poverty, and it estimates the average distance separating the income of the poor from the poverty line as a proportion of the income indicated by the line. The final indicator, the squared poverty gap index, also measures the severity of poverty, quantifies the aversion of the society towards poverty. We adopt the representative household approach and use the vectors of consumption resulting from the dynamic model to generate the consumption vectors based on the household survey. (Poverty analysis is performed with DAD software). We use two different poverty lines for rural and urban households which are endogenously determined by the model taking into account the rural and urban CPIs.

7. Dissemination Strategy

The outcome of the proposed research will be disseminated to the academics, policy makers and the publics. A full research report will be produced. Also, findings of the research will be presented in the workshops and seminars both at the national and international levels.
An interim report will be produced by December 2005 and the first draft of the full report will be presented at the forthcoming PEP conference in 2006. The final version of the paper will be submitted after receiving the comments at the conference.

8. Prior Training and Experience of the Researcher

The team leader of this proposed research has experiences of working on CGE models. The team leader developed an intertemporal dynamic CGE model of Bangladesh in one of his PhD chapters. He also has produced a number of papers with other researchers on CGE models and has presented them in international conferences. He has worked, along with his co-authors, on a chapter on a sequential dynamic CGE model of Bangladesh in a forthcoming book edited by Tomas Hertel and Alan Winters.

9. A list of research projects performed by the researcher

The team leader has worked, together with his co-authors, on a paper titled “Implications of WTO Agreements and Domestic Trade Policy Reforms for Poverty in Bangladesh: A Study in a Sequential Dynamic CGE Framework” for a forthcoming book “Putting Development Back to the Doha Agenda: Poverty Implications of WTO Agreement”, edited by Tom Hertel and Alan Winters. The project is funded by the World Bank.

10. Expected capacity building of the researchers and their institutions

Through the participation of the proposed research project the researchers expect to build and enhance their skills on CGE modelling. The team leader Selim Raihan has done some CGE researches and is capable of pursuing the CGE techniques. Muhammad Jami Husain has been involved with the development of SAM for Bangladesh under the Sustainable Human Development (SHD) project of the UNDP and the Planning Commission of Bangladesh. He intends to build his skills on CGE modelling techniques. Finally, Syama H. Bidisha is a very new entrant in the CGE world. She intends to be familiar with the CGE literature and build her capacity to apply CGE techniques. Only the team leader knows how to apply GAMS for CGE modelling and he will pass this knowledge to the other members in the team. Through the review of the literature and exploration of the current state of art in Bangladesh the proposed research will also help the researchers in the team to enhance their understanding of the gender aspects of policy reforms. Two
members of the team (Selim Raihan and Syama H. Bidisha) teach economics at the University of Dhaka, Bangladesh. The knowledge gathered through this research will enhance their teaching capabilities, and the students in the University of Dhaka are expected to be benefited from this.

In terms of the division of work the team leader Selim Raihan will be responsible for the overall execution of the project. Muhammad Jami Husain will be particularly responsible for handling the problems associated with the SAM 2000 of Bangladesh. Sayma H. Bidisha will be particularly responsible for reviewing the literature on gender and other policy reforms in line with the objectives of the research.

11. Any negative implications of the project for the social or gender groups, or for the natural environment

Not Applicable
References


Hertel, T. and Winters, A. (2005), *Putting Development Back to the Doha Agenda*. (Forthcoing)


Annex 1

Sequential Dynamic CGE Model Structure used in Annabi et al. (2004)

Production

(1) \[ XS_j = \min \left[ \frac{CI_j}{w_j}, \frac{VA_j}{v_j} \right] \]

(2) \[ VA_i = A_{i}^{KL} \left[ \alpha_i^{KL} LD_i^{-\rho_i^{KL}} + (1 - \alpha_i^{KL}) KD_i^{-\rho_i^{KL}} \right]^{1/\rho_i^{KL}} \]

(3) \[ LD_i = A_{i}^{LQ} \left[ \alpha_i^{LQ} QL_i^{-\rho_i^{LQ}} + (1 - \alpha_i^{LQ}) NQL_i^{-\rho_i^{LQ}} \right]^{1/\rho_i^{LQ}} \]

(4) \[ CI_j = io_j XS_j \]

(5) \[ DI_{ij,j} = a_{ij,j} CI_j \]

(6) \[ LD_i = \left( \frac{\alpha_i^{KL}}{1 - \alpha_i^{KL}} \right)^{\frac{1}{\rho_i^{KL}}} \left( \frac{r_i}{w_i} \right)^{\frac{1}{\rho_i^{KL}}} KD_i \]

(7) \[ NQL_i = \left( \frac{\alpha_i^{LQ}}{1 - \alpha_i^{LQ}} \right)^{\frac{1}{\rho_i^{LQ}}} \left( \frac{wq_i}{wnq_i} \right)^{\frac{1}{\rho_i^{LQ}}} QL_i \]

Income and savings

\[ YH_h = \lambda_h^{WQ} \cdot wq \sum_j QL_j + \lambda_h^{WNQ} \cdot wnq \sum_j NQL_j + \lambda_h^R \sum_{nag} K D_{nag} \]

\[ + \lambda_h^L \cdot \sum_{nag} K D_{nag} + P \text{index} \cdot TG_h + P \text{index} \cdot TH_{h,j} + P \text{index} \cdot TH_{h,j} + P \text{index} \cdot TH_{h,j} - T_{WH_h} + \text{DIV}_h \]

(8) \[ YD_{h} = YH_{h} - DTH_{h} \]

(9) \[ SH_h = \nu \cdot \psi_h \cdot YD_{h} \]

(10) \[ YF = \lambda^L \sum_i r_i KD_i + \lambda^L \cdot r_i \cdot LAND \]

(11) \[ SF = YF - \sum_h \text{DIV}_h - e \cdot \text{DIV}^{\text{ROW}} - \text{DTF} \]

(12) \[ YG = \sum_i TI_i + \sum_i TIE_i + \sum_i TIM_i + \sum_h DTH_h + \text{DTF} \]

(13) \[ SG = YG - G - P\text{INDEX} \sum_h TG_h \]

(14) \[ T I_i = t_{ri} \left( P_x S_i - P E_i E X_i \right) + t_{ri} \left( 1 + t_{ri} \right) e \cdot PWM_i M_i \]

(15) \[ T I M_i = t_{ri} e \cdot PWM_i M_i \]

(16) \[ T I E_i = t_{ri} P E_i E X_i \]

(17) \[ DTH_h = ty_h YH_h \]

(18) \[ DTF = ty_f \cdot YF \]
Demand

(20) \( CTH_h = YDH_h - SH_h \)

(21) \( PC_iC_{i,h} = PC_iC_{i,h}^{\text{min}} + \gamma_{i,h} \left( CTH_h - \sum_j PC_jC_{j,h}^{\text{min}} \right) \)

(22) \( G = CG_{ser}PC_{ser} \)

(23) \( INV_i = \frac{\mu_{IT}}{PC_i} \)

(24) \( DIT_i = \sum_j DI_j \)

Prices

(25) \( PV_j = \frac{P_jXS_j - \sum_j PC_iDI_{i,j}}{VA_j} \)

(26) \( r_i = \frac{PV_jVA_i - w_iLD_i}{KD_i} \)

(27) \( w_i = \frac{wq \cdot QL_i - wnq \cdot NQL_i}{LD_i} \)

(28) \( PD_i = (1 + tx_i) \cdot PL_i \)

(29) \( PM_i = (1 + tx_i) \cdot (1 + tm_i) \cdot e \cdot PWM_i \)

(30) \( PE_i = \frac{e \cdot PE_{-FOB_i}}{1 + tx_i} \)

(31) \( PC_iQ_i = PD_iD_i + PM_iM_i \)

(32) \( P_iXS_i = PL_iD_i + PE_iEX_i \)

(33) \( P_{inv} = \prod_i \left( \frac{PC_i}{\mu_i} \right)^{\mu_i} \)

(34) \( P\text{index} = \sum_i \delta_iPV_i \)

International Trade

(35) \( XS_i = B_i^{E} \left[ \beta_i^EEX_i^{E \ast} + (1 - \beta_i^E) \cdot D_i^{E \ast} \right]^{1/\kappa^E} \)

(36) \( EX_i = \left[ \left( \frac{PE_i}{PL_i} \right) \left( 1 - \frac{\beta_i^E}{\beta_i^E} \right) \right]^{\kappa^E} D_i \)

(37) \( EXD_i = EXD_i^{\ast} \cdot \left( \frac{PWE_i}{PE_{-FOB_i}} \right)^{\text{dust}} \)

(38) \( Q_i = A_i^{M} \left[ \alpha_i^{M} M_i^{\ast -\alpha_i^{M}} + (1 - \alpha_i^{M}) \cdot D_i^{-\alpha_i^{M}} \right]^{1/\rho_i^{M}} \)

(39) \( M_i = \left[ \left( \frac{PD_i}{PM_i} \right) \left( 1 - \alpha_i^{M} \right) \right]^{\rho_i^{M}} \cdot D_i \)
\[ CAB = \sum_i PWM_i M_i + \lambda^{ROW} \sum_i \alpha_i K_i / e \]

\[ + DIV^{ROW} - \sum_i PE - FOB, EX_i \]

**Equilibrium**

(41) \[ Q_i = DIT_i + \sum_h C_{ih} + INV_i + Dstk_i \]

(42) \[ EX_i = EXD_i \]

(43) \[ LSQ = \sum_j QL_j \]

(44) \[ LSNQ = \sum_j NQL_j \]

(45) \[ IT + \sum_i PC_i Dstk_i = \sum_h SH_h + SF + SG + e \cdot CAB \]

**Dynamic Equations**

(46) \[ KD_{it+1} = (1 - \delta) KD_{it} + Ind_{it} \]

(47) \[ LSQ_{it+1} = (1 + ng) \cdot LSQ_i \]

(48) \[ LSNQ_{it+1} = (1 + ng) \cdot NQL_i \]

(49) \[ C_{ih,t+1}^{min} = (1 + ng) \cdot C_{ih,t}^{min} \]

(50) \[ \frac{Ind_{it}}{KD_{it}} = A^R \left( \frac{R_{it}}{U_{it}} \right)^2 \]

(51) \[ U_{it} = Pinv_i \cdot (ir + \delta_i) \]

(52) \[ IT_i = Pinv_i \cdot \sum_i Ind_{it} \]

(53) \[ SG_{it+1} = (1 + ng) \cdot SG_i \]

(54) \[ CAB_{it+1} = (1 + ng) \cdot CAB_i \]

(55) \[ TG_{it+1} = (1 + ng) \cdot TG_i \]

(56) \[ CG_{it+1} = (1 + ng) \cdot CG_i \]

(57) \[ Dstk_{it+1} = (1 + ng) \cdot Dstk_i \]

(58) \[ DIV_{it+1} = (1 + ng) \cdot DIV_i \]

(59) \[ DIV_\_ROW_{it+1} = (1 + ng) \cdot DIV_\_ROW_i \]

(60) \[ TWH_{it+1} = (1 + ng) \cdot TWH_i \]

(61) \[ TH_{h,hj,t+1} = (1 + ng) \cdot TH_{h,hj,t} \]

(62) \[ EXD_{it+1} = (1 + ng) \cdot EXD_i \]
Endogenous variables

\[ C_{i,h} : \text{Household } h \text{'s consumption of good } i \text{ (volume)} \]
\[ CF : \text{Composite agricultural capital-labor factor (volume)} \]
\[ CI_j : \text{Total intermediate consumption of activity } j \text{ (volume)} \]
\[ CTH_h : \text{Household } h \text{'s total consumption (value)} \]
\[ D_i : \text{Demand for domestic good } i \text{ (volume)} \]
\[ DI_{ij} : \text{Intermediate consumption of good } i \text{ in activity } j \text{ (volume)} \]
\[ DIT_i : \text{Intermediate demand for good } i \text{ (volume)} \]
\[ DTF : \text{Receipts from direct taxation on firms' income} \]
\[ DTH_h : \text{Receipts from direct taxation on household } h \text{'s income} \]
\[ EX_i : \text{Exports in good } i \text{ (volume)} \]
\[ G : \text{Public expenditures} \]
\[ INV_i : \text{Investment demand for good } i \text{ (volume)} \]
\[ IT : \text{Total investment} \]
\[ LD_j : \text{Activity } j \text{'s demand for labor (volume)} \]
\[ M_i : \text{Imports in good } i \text{ (volume)} \]
\[ P_i : \text{Producer price of good } i \]
\[ PC_i : \text{Consumer price of composite good } i \]
\[ PD_i : \text{Domestic price of good } i \text{ including taxes} \]
\[ PE_i : \text{Domestic price of exported good } i \]
\[ Pindex : \text{GDP deflator} \]
\[ Pinv : \text{Price index of investment} \]
\[ PL_i : \text{Domestic price of good } i \text{ (excluding taxes)} \]
\[ PM_i : \text{Domestic price of imported good } i \]
\[ PV_j : \text{Value added price for activity } j \]
\[ Q_i : \text{Demand for composite good } i \text{ (volume)} \]
\[ r_i : \text{Rate of return to capital in activity } i \]
\[ rL : \text{Rate of return to agricultural land} \]
\[ rc : \text{Rate of return to composite factor} \]
\[ SF : \text{Firms' savings} \]
\[ SG : \text{Government's savings} \]
\[ SH_h : \text{Household } h \text{'s savings} \]
\[ TI_i : \text{Receipts from indirect tax on } i \]
\[ TIE_i : \text{Receipts from tax on export } i \]
\[ TIM_i : \text{Receipts from import duties } i \]
\[ VA_j : \text{Value added for activity } j \text{ (volume)} \]
\[ w : \text{Wage rate} \]
\[ XS_i : \text{Output of activity } i \text{ (volume)} \]
\[ YDH_h : \text{Household } h \text{'s disposable income} \]
\[ YF : \text{Firms' income} \]
\[ YG : \text{Government's income} \]
\[ YH_h : \text{Household } h \text{'s income} \]
\[ LS : \text{Total labor supply (volume)} \]
\[ KD_i : \text{Demand for capital in activity } i \text{ (volume)} \]
\[ CAB : \text{Current account balance} \]
\[ Ind_{i,j} : \text{Demand for capital in activity } i \text{ (volume)} \]
\[ U_t : \text{Capital user cost} \]
\[ C_{i,h}^{\text{min}} : \text{Minimum consumption of good } i \text{ by household } h \]
Exogenous variables

\[ PWE_i : \text{World price of export } i \]
\[ PWM_i : \text{World price of import } I \]
\[ e : \text{Nominal Exchange rate (numéraire)} \]

Parameters

Production functions

\[ A_j : \text{Scale coefficient (Cobb-Douglas production function)} \]
\[ a_{ij,j} : \text{Input-output coefficient} \]
\[ \alpha_j : \text{Elasticity (Cobb-Douglas production function)} \]
\[ io_j : \text{Technical coefficient (Leontief production function)} \]
\[ v_j : \text{Technical coefficient (Leontief production function)} \]

CES function between capital and labor

\[ A^{KL}_i : \text{Scale coefficient} \]
\[ \alpha^{KL}_i : \text{Share parameter} \]
\[ \rho^{KL}_i : \text{Substitution parameter} \]
\[ \sigma^{KL}_i : \text{Substitution elasticity} \]

CES function between skilled and unskilled labor

\[ A^{LL}_i : \text{Scale coefficient} \]
\[ \alpha^{LL}_i : \text{Share parameter} \]
\[ \rho^{LL}_i : \text{Substitution parameter} \]
\[ \sigma^{LL}_i : \text{Substitution elasticity} \]

CES function between imports and domestic production

\[ A^M_i : \text{Scale coefficient} \]
\[ \alpha^M_i : \text{Share parameter} \]
\[ \rho^M_i : \text{Substitution parameter} \]
\[ \sigma^M_i : \text{Substitution elasticity} \]

CET function between domestic production and exports

\[ B^E_i : \text{Scale coefficient} \]
\[ \beta^E_i : \text{Share parameter} \]
\[ \kappa^E_i : \text{Transformation parameter} \]
\[ \tau^E_i : \text{Transformation elasticity} \]

LES consumption function

\[ \gamma_{i,j} : \text{Marginal share of good } i \]
Tax rates

\( t_{ei} \) : Tax on exports \( i \)  
\( tm_{i} \) : Import duties on good \( i \)  
\( tx_{i} \) : Tax rate on good \( i \)  
\( ty_{h_{h}} \) : Direct tax rate on household \( h \)'s income  
\( ty_{f} \) : Direct tax rate on firms' income

Other parameters

\( \delta_{j} \) : Share of activity \( j \) in total value added  
\( \lambda_{h}^{L} \) : Share of land income received by household \( h \)  
\( \lambda_{h}^{LF} \) : Share of land income received by firms  
\( \lambda_{h}^{ROW} \) : Share of land income received by foreigners  
\( \lambda_{h}^{R} \) : Share of capital income received by household \( h \)  
\( \lambda_{h}^{RF} \) : Share of capital income received by firms  
\( \lambda_{h}^{ROW} \) : Share of capital income received by foreigners  
\( \lambda_{h}^{W} \) : Share of labour income received by household \( h \)  
\( \psi_{h} \) : Propensity to save  
\( \mu_{i} \) : Share of the value of good \( i \) in total investment  
\( ng \) : Population growth rate  
\( \delta \) : Capital depreciation rate  
\( \gamma_{1i} \) : Parameter in the investment demand function  
\( \gamma_{2i} \) : Parameter in the investment demand function  
\( ir \) : Real interest rate
Annex 2:
Modelling Gender Leisure, Work in the Market and Home Production

From Fofana et al. (2003):

Following Graham and Green (1984), gender leisure \((LE_{mal}^h, LE_{fem}^h)\) and household home production \((CZ_h)\) are incorporated in a Stone and Geary utility function:

\[
U_h = \left( LE_{mal}^h - \overline{LE}_{mal}^h \right)^{\beta_{mal}} \left( LE_{fem}^h - \overline{LE}_{fem}^h \right)^{\beta_{fem}} \left( CZ_h - \overline{CZ}_h \right)^{\beta_h} \prod_i \left( C_i^h - \overline{C}_i^h \right)^{\beta_i} \tag{1.1}
\]

\(\overline{LE}_{mal}\) and \(\overline{LE}_{fem}\) = minimum subsistence volumes of male and female non-market work required by household \(h\);

\(C_i^h\) and \(\overline{C}_i\) = minimum subsistence and total quantities of commodity \(i\).

\(\beta\) = marginal budget share that determine the allocation of supernumerary income.

The household produces a single commodity, aggregation of domestic goods its members produce at home. It faces the following constraints:

**Home production technology:**

\[
Z_h = f \left( LZ_{mal}^h, LZ_{fem}^h \right) \tag{1.2}
\]

\(LZ_{mal}\) et \(LZ_{fem}\) are male and female time used to produce home commodities

- **budget:**

\[
\sum_i P_{i,h} C_{i,h} = R_h + w_{mal} LM_{mal}^h + w_{fem} LM_{fem}^h = Y_h \tag{1.3}
\]

Where \(Y\) = household \(h\) real income; \(LM_{mal}\) and \(LM_{fem}\) = male and female market work; \(w_{mal}\) and \(w_{fem}\) = male and female wage rate; \(R\) = non-labour income; \(P\) = market goods price.

- **Time:**

\[
T_{mal}^h = LM_{mal}^h + LZ_{mal}^h + LE_{mal}^h \tag{1.4}
\]

\[
T_{fem}^h = LM_{fem}^h + LZ_{fem}^h + LE_{fem}^h \tag{1.5}
\]

\(T_{mal}\) and \(T_{fem}\) are the total time endowment for men and women.
The household’s full income (FY) is obtained from (1.3), (1.4) and (1.5)

\[ \sum P_{i,h} c_{i,h} + P_h^z CZ_h + w_{mal} LEmal_h + w_{fem} LEfem_h = FY_h \] (1.6)

With

\[ FY_h = R_h + w_{mal} LMal_h + w_{fem} LMFem_h + w_{mal} LEmal_h + w_{fem} LEfem_h + P_h^z Z_h \] (1.7)

And,

\[ FY_h = Y_h + w_{mal} LEmal_h + w_{fem} LEfem_h + P_h^z Z_h \] (1.8)

Demand functions obtained from the utility (1.1) maximization, subject to constraint (1.7) are:

\[ C_{i,h} = \overline{C}_{i,h} + \frac{\beta^i_h \left[ FY_h - \sum_i P_i \overline{C}_{i,h} - P_h^z \overline{CZ}_h - w_{mal} \overline{LEmal}_h - w_{fem} \overline{LEfem}_h \right]}{P_i} \] (1.9)

\[ CZ_h = \overline{CZ}_h + \frac{\beta^z_h \left[ FY_h - \sum_i P_i \overline{C}_{i,h} - P_h^z \overline{CZ}_h - w_{mal} \overline{LEmal}_h - w_{fem} \overline{LEfem}_h \right]}{P_h^z} \] (1.10)

\[ LEmal_h = \overline{LEmal}_h + \frac{\beta^mal_h \left[ FY_h - \sum_i P_i \overline{C}_{i,h} - P_h^z \overline{CZ}_h - w_{mal} \overline{LEmal}_h - w_{fem} \overline{LEfem}_h \right]}{w_{mal}} \] (1.11)

\[ LEfem_h = \overline{LEfem}_h + \frac{\beta^fem_h \left[ FY_h - \sum_i P_i \overline{C}_{i,h} - P_h^z \overline{CZ}_h - w_{mal} \overline{LEmal}_h - w_{fem} \overline{LEfem}_h \right]}{w_{fem}} \] (1.12)

Substituting equations (1.7) and (1.8), into (1.9), (1.10), (1.11) and (1.12), after rearranging, gives:
Following De Melo and Tarr (1971) method, it can be written that:

\[ MAXHRS_{\text{mal}} = T_{\text{mal}} - \bar{E}_{\text{mal}}; \]

\[ MAXHRS_{\text{fem}} = T_{\text{fem}} - \bar{E}_{\text{fem}} \]

and

\[ LM_{\text{mal}} = MAXHRS_{\text{mal}} - LZ_{\text{mal}} - \frac{\beta_{\text{mal}}^{\text{mal}} \left( Y_{h} - \sum_{i} P_{i} \bar{C}_{i,h} \right)}{W_{\text{mal}} \left( 1 - \beta_{h}^{\text{mal}} - \beta_{h}^{\text{fem}} - \beta_{h}^{\text{z}} \right)} \]

\[ LM_{\text{fem}} = MAXHRS_{\text{fem}} - LZ_{\text{fem}} - \frac{\beta_{h}^{\text{fem}} \left( Y_{h} - \sum_{i} P_{i} \bar{C}_{i,h} \right)}{W_{\text{fem}} \left( 1 - \beta_{h}^{\text{mal}} - \beta_{h}^{\text{fem}} - \beta_{h}^{\text{z}} \right)} \]

Where MAXHRS = maximum total time available for men and women for leisure, market work and home production. Equation (1.10) replaces the equation (21) of the original model in Annex-1. The additional equations are: (1.2), (1.11), (1.12), (1.13), (1.15), (1.16) and (1.17). Furthermore, the equations (3), (7), (43) and (44) of the original model.
are changed in our model taking into consideration the gendered labour factors. On the other hand, the equations (47) and (48) of the original model are dropped and two new equations are introduced to express that the maximum total time available for men and women ($MAXHRSmal$ and $MAXHRSfem$) increase at an exogenous rate.

The additional base year data needed for parameter calibration are:
- Male and female labour remuneration in all sectors;
- Male and female wage income in all households;
- Sectoral elasticities of substitution between male and female labour in market work;
- Male and female maximum time devoted to market work, leisure and home production (MAXHOURS);
- Time devoted by men and women to home production activities
- The elasticity of substitution between male and female labour in home production
- The minimum consumption level of home produced goods

We follow the same procedures for the calibration of parameters and the calibration of gender maximum time available to market work, leisure and domestic production as have been done by Fofana et al. (2003).