Impact of Trade Liberalisation on Employment in Bangladesh: A Computable General Equilibrium (CGE) Analysis

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Abstract: We use a 86-industry CGE model of Bangladesh to simulate the employment effects of removing all tariffs in Bangladesh. We find that this would expand GDP and generate employment. The industries that experience the greatest positive effects on their output and employment are the export-oriented industries. There are also positive effects on the suppliers to these industries. Lightly-protected industries that rely heavily on imported intermediate inputs exhibit robust expansion as they benefit from a cost reduction. In contrast, highly-protected industries demonstrate contraction. The occupational pattern of the employment results indicates that expansion is felt most heavily in the export sector (export-related occupation experiences the largest increase).

1 Introduction

Bangladesh, one of the world's most densely populated poverty-stricken countries, has undertaken trade liberalisation at a pace deemed to be faster than many of its neighbours, making it one of the most open economies in the South Asian region. It is widely believed that trade liberalisation causes structural adjustment across various sectors in the economy. Normally, as a result of trade liberalisation, some sectors expand and some contract, according to their comparative advantages in the old and new economic environments. In particular, labour demand in each sector will adjust correspondingly. The relationship between trade liberalisation and employment is explored in this present study using the example of Bangladesh, where trade policies were dramatically liberalised in the early 1990s.

The main objective of this study is to develop a large-scale computable general equilibrium (CGE) model of the Bangladesh economy, and undertake a counterfactual policy simulation to examine the short-run effects of trade liberalisation on macroeconomic indicators and sectoral output and employment. In order to achieve the above objectives, the remainder of the paper is organised as

follows. Section Two presents an overview of trade policy reforms and the structure of employment in Bangladesh. Then the theoretical structure of the Bangladesh CGE model is briefly described in Section Three. Details of the simulation and results for macroeconomic variables and for output and employment by sector are discussed in Section Four. Section Five provides concluding comments.

2 Trade Reforms and Employment Structure in Bangladesh: An Overview

2.1 Trade Policy Reforms

After gaining independence in 1971, Bangladesh, like other South Asian neighbours, adopted an inward looking import-substitution growth strategy. This was supported by a number of protective and concessionary measures namely quantitative restrictions, restricted import licensing, differentiated and high rates of nominal tariffs, an overvalued domestic currency and subsidised loans to traded goods sectors. These distorted incentives led to allocative and productive inefficiencies and created an anti-export bias. As a result, the economy experienced a low growth rate: GDP only grew at an average annual rate of 2.5 percent between 1970 and 1980 (World Bank, 1991). This prompted policy makers to introduce reforms towards a free market economy and export-led industrialisation in the early 1980s. Since then the liberalisation policies adopted by Bangladesh have passed through three phases.

The first rigorous effort aimed at reforming the previous import-substitution trade and investment regime was undertaken in the early 1980s with the introduction of the New Industrial Policy of 1982 (NIP-82). The primary objective of NIP-82 was to encourage greater participation of the private sector in the industrialisation of the country. This phase of reform covering the period between 1981-82 to 1985-86 saw a number of important initiatives towards liberalisation of the economy, namely, a

move from the positive (allowable commodities) list of import control to a negative (commodities not allowed to be imported) list, reduction in the number of commodities which were not allowed to be imported, expansion of export performance benefits, and institution of duty drawback facilities to encourage export sectors.

The second phase was launched in 1986 to match with the Revised Industrial Policy (RIP-86) and covered the period between 1986-87 and 1990-91. During this phase there was a substantial reduction in quantitative restrictions (QRs) on imports. The total number of QRs came down from 478 to 239 between 1985-86 and 1990-91 (Table 1). Moreover, during this phase, a significant reduction in the anti-export bias was achieved through rationalisation of tariffs as well as through the introduction of a scheme of incentives for export-oriented activities. The export incentives provided include zero-tariff on imported inputs and special support for economic activities in export processing zones (EPZs).

Table 1: Removal of Quantitative Restrictions (QRs)

Year	Total	Trade reasons			Non-trade reasons
		Banned	Restricted	Mixed	
1985-86	478	275	138	16	49
1986-87	550	252	151	86	61
1987-88	529	257	133	79	60
1988-89	433	165	89	101	78
1989-90	315	135	66	52	62
1990-91	239	93	47	39	60
1991-92	193	78	34	25	56
1992-93	93	13	12	14	54
1993-94	109	7	19	14	69
1995-97	120	5	6	17	92
1997-02	124	5	6	17	96

Source: Data for the year 1985-86 to 1993-94 are from Rahman and Bhattacharya (2000), p. 5 and data for the year 1995-97 and 1997-2002 are from Fontana et al. (2001) p. 25.

The third phase of the reforms, introduced in 1991-92, was the most comprehensive compared to the reforms of the earlier two phases. This phase, in fact, overlapped with the Structural Adjustment Programme (SAP) which was being implemented in Bangladesh over the same period of time. The SAP brought about important and profound reforms in the trade, investment, fiscal, financial and institutional policies in Bangladesh for the greater openness of the economy. During the 1990s QRs and average tariff rates were dramatically reduced. For example, the total number of QRs for trade reasons came down from 179 to only 28 between 1990-91 and 1997-02 (Table 1), and the import-weighted average tariff rate was reduced from 23.6 percent in 1992-93 to 9.7 percent in 2001-02 (Table 2).

Table 2: Trend of Average Tariff Rates (percent)

Year	Unweighted average	Import-weighted average
1992-93	47.4	23.6
1993-94	36.0	24.1
1994-95	25.9	20.8
1995-96	22.3	17.0
1996-97	21.5	18.0
1997-98	20.7	16.0
1998-99	20.3	14.1
1999-00	19.5	13.8
2000-01	18.6	15.1
2001-02	17.1	9.7

Source: GOB (2003a) p. 51.

Table 3 shows the changes in the degree of international openness of Bangladesh, Pakistan, Sri Lanka and India during 1990-2000. It may be noted that in 1990 Sri Lanka was the most open economy according to the three measurements of international openness, namely export propensity, import penetration and trade ratio, Pakistan was the second, Bangladesh placed third and India was the least open economy. Sri Lanka continued to remain the most open economy in 2000 while

Bangladesh moved to the second place. It may further be noted that in Bangladesh, openness took place at a considerably faster rate during 1990-2000 than for its neighbours. As a result, Bangladesh became one of the most open economies in the South Asian region.

Table 3: Degree of International Openness for Bangladesh, Pakistan, Sri Lanka and India

	Year	1990	1995	2000
Bangladesh	Export propensity	8.3	14.2	17.5
	Import penetration	16.7	20.8	23.0
	Trade ratio	26.7	36.6	42.1
Pakistan	Export propensity	14.8	16.7	16.2
	Import penetration	19.2	18.9	17.9
	Trade ratio	35.1	36.1	34.5
Sri Lanka	Export propensity	30.2	35.6	39.1
	Import penetration	35.3	41.7	44.9
	Trade ratio	68.2	81.6	88.8
India	Export propensity	7.1	11.1	n.a.
	Import penetration	8.4	12.1	n.a.
	Trade ratio	15.7	23.3	19.4

Notes: *(i) Export propensity: (Exports of goods and services)/GDP*100*
*(ii) Import penetration: (Imports of goods and services)/(GDP + trade surplus or deficit)*100*
*(iii) Trade ratio: (Exports of goods and services + imports of goods and services)/GDP*100*
(iv) n.a. refers to not available

Source: GOB (2003a) p. 55.

2.2 Structure of Employment

The general employment trend in Bangladesh indicates that the level of employment had risen towards 1995-96 (Table 4). For instance, the overall level of employment had risen to 54.6 million in 1995-96 from 49.9 million in 1989 (i.e. an increase of 9.4 percent). If we consider employment in agriculture and non-agriculture sectors separately, it can be seen that employment in non-agriculture sector had risen at a faster rate (15.6 percent) compared to agriculture sector (5.6 percent) between 1989 and 1995-96. Table 4 also shows that while the level of employment in the industrial sector was declining over time (i.e. a fall of 33.3 percent between 1989 and

1995-96), the level of employment in the services sector was rising sharply (i.e. an increase of 55.8 percent during the same period of time). While the share of non-agriculture employment increased to 36.8 percent in 1995-96 from 34.9 percent 1989, and the share of agriculture employment declined to 63.2 percent in 1995-96 from 65.1 percent during the same period of time.

Table 4: Sectoral Distribution of Employment

(million workers)

Sector	LFS 1989	LFS 1990-91	LFS 1995-96
Total	49.9 (100.0)	50.2 (100.0)	54.6 (100.0)
Agriculture	32.6 (65.1)	33.3 (65.9)	34.5 (63.2)
Non-agriculture	17.3 (34.9)	16.9 (34.1)	20.0 (36.8)
Services	9.5 (19.3)	10.4 (21.2)	14.8 (27.3)
Industry	7.8 (15.6)	6.5 (12.9)	5.2 (9.5)

Notes: *(i) LFS refers to Labour Force Survey, and figures in parentheses are respective percentage shares in total employment*

(ii) Industry sector includes manufacturing, construction, mining and quarrying, and gas, electricity and water sectors

(iii) Services sector includes trade, hotel and restaurants, transport and communication, banking and insurance, and other services.

Source: *Rashid (2000), p. 51.*

Table 5 shows the percentage distribution of employed persons by sex, residence and major industry in year 1995-96. Data reveal that in Bangladesh, agriculture sector accounts for the largest share in total employment, with 63 percent of labour in 1995-96 (53.1 percent of male labour and 79.2 percent of female labour) was employed in this sector. The second highest employment sector was trade, hotel and restaurants which provided employment for 12.3 percent of the labour force. In the urban area, men were mostly employed in the service sectors (particularly trade, hotel and restaurants; community and personal services; and transport, storage and communication), while women were more employed in the manufacturing sector and in the community and personal services. Table 5 also suggests that in the rural area,

agriculture was the primary source of employment for both men and women. The other important activities in the rural area were trade, hotel and restaurants (for men), and manufacturing, and community and personal services (for both men and women).

Table 5: Employed Persons by Sex, Residence, and Industry in 1995-96 (in percent)

	Urban			Rural			Bangladesh		
Major industries	Male	Female	All	Male	Female	All	Male	Female	All
Agriculture, forestry, fisheries	12.1	37.4	18.6	64.2	85.0	72.7	53.1	79.2	63.0
Mining and quarrying	0.2	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0
Manufacturing	14.3	20.1	15.8	5.7	5.4	5.6	7.5	7.2	7.4
Electricity, water and gas	0.7	0.3	0.6	0.2	0.0	0.1	0.3	0.1	0.2
Construction	4.3	0.7	3.3	2.8	0.4	1.8	3.1	0.4	2.1
Trade, hotel and restaurants	31.7	5.9	25	14.7	2.2	9.6	18.3	2.6	12.3
Transport, storage and communication	14.3	0.9	10.8	5.1	0.2	3.1	7.1	0.2	4.5
Finance, business services	2.1	0.4	1.7	0.3	0.0	0.2	0.6	0.1	0.4
Community and personal services	19.8	31.8	22.9	6.5	5.7	6.2	9.4	8.9	9.2
Household sector and others	0.6	2.5	1.1	0.6	1.1	0.8	0.6	1.3	0.8
All Industry	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Author's calculations from GOB (1996) p.45.

The manufacturing sector in Bangladesh has witnessed significant shifts in the pattern of employment in the past three decades. The most dramatic change was a sharp decline in the employment share of textiles from 64.9 percent in 1975-80 to 39.8 percent in 1991-95 (Table 6). On the other hand, the manufacturing sectors of wearing apparel and leather products increased their shares of total employment in the period 1975-1995. For instance, the employment share of wearing apparel, except footwear increased to 10.2 percent in 1991-95 from 0.2 percent in 1975-80 and the employment share of leather products increased to 15.5 percent in 1991-95 from 0.7 percent in 1975-80.

Table 7 shows labour value added by aggregated activity and type of labour in the years 1999-2000. Note that Table 7 is produced from the 1999-2000 input output table for Bangladesh which is the main data source for this study. Overall, labour

share in total value added was 44.1 percent. The activities that were highly labour intensive were public services, textile clothing and footwear (hereafter, TCF), and private services: share of labour in the total value added accounted for 71.8 percent (public services), 61.8 percent (TCF) and 54.4 percent (private services). On the other hand, less-labour intensive activities were tobacco products and utilities: share of labour in the total value added accounted for only 18.0 percent (tobacco products) and 23.0 percent (utilities). Note that the share of labour in total value added in housing service activity was zero because of the fact that this activity only used capital.

Table 6: The Structure of Employment in the Manufacturing Sectors, 1975-1995

Industry	1975-80	1981-85	1986-90	1991-95
Food products (311)	10.8	9.6	10.8	8.6
Beverages (313)	0.2	0.2	0.1	0.1
Tobacco (314)	1.5	1.4	1.9	6.0
Textiles (321)	64.9	64.9	56.8	39.8
Wearing apparel, except footwear (322)	0.2	1.1	8.3	10.2
Leather products (323)	0.7	0.7	0.9	15.5
Footwear, except rubber and plastic (324)	0.2	0.3	0.3	0.5
Wood products, except furniture (331)	0.3	0.5	0.8	1.0
Furniture, except metal (332)	0.3	0.3	0.3	0.3
Paper and products (341)	2.4	2.0	1.8	1.1
Printing and publishing (342)	1.1	1.4	1.7	1.4
Industrial chemicals (351)	1.4	1.3	2.3	1.5
Other chemicals (352)	6.1	6.2	3.8	1.8
Petroleum refineries (353)	0.1	0.1	0.1	0.6
Rubber products (355)	0.6	0.4	0.3	0.2
Plastic products (356)	0.1	0.2	0.3	0.3
Pottery, china and earth ware (361)	0.2	0.3	0.4	0.6
Glass products (362)	0.6	0.4	0.3	0.2
Other non-metallic mineral products (369)	0.6	0.7	1.1	4.1
Iron and steel (371)	2.4	2.1	1.8	1.2
Fabricated metal products (381)	2.0	2.3	2.2	1.4
Machinery, except electrical (382)	0.9	1.4	1.0	0.5
Machinery, electric (383)	1.1	1.4	1.6	0.9
Transport equipment (384)	1.2	1.0	1.0	1.5
Professional and scientific equipment (385)	0.0	0.0	0.0	0.9

Notes: (i) All figures are percentage shares in total employment of manufacturing sector.
(ii) 3-digit ISIC code in brackets in first column.

Source: Sen (2005), p. 9.

Table 7 also reveals that the share of male labour in total labour value added was 86.7 percent and the remaining 13.3 percent accounted for female labour. Except TCF, in all other activities, the share of male labour in total labour value added was more than 80 percent (in case of TCF this share was 55 percent). On the contrary, except TCF in all other activities, the share of female labour in total labour value added was less than 20 percent (in case of TCF this share was 45 percent). Considering eight labour groups, the share of highly educated male labour (class XI and above) i.e. LEdu3M in total labour value added was the highest (28.7 percent) and the corresponding lowest figure was 1.8 percent in case of female labour with medium education (class VI to class X) i.e. LEdu2F. The share of illiterate male labour (no formal schooling) i.e. LEdu0M in the total labour value added was highest for the following activities: forestry (47.8 percent), transport (47.8 percent), non-metal products (41.1 percent), agriculture (39.4 percent), construction (35.3 percent), and wood and paper products (22.3 percent). The share of male labour with low education (class I to class V) i.e. LEdu1M in the total labour value added was highest for the following activities: metal products (33.9 percent), machinery and equipment (32.8 percent) and trade (26.2 percent). The share of male labour with medium education (class VI to class X) i.e. LEdu2M in the total labour value added was highest for the following activities: fishing (30.2 percent), food process (26.4 percent) and tobacco products (22.9 percent). The share of LEdu3M in the total labour value added was highest for the following activities: utilities (66.7 percent), mining and quarrying (66.7 percent), public services (65.9 percent), private services (54.4 percent), chemicals (41.9 percent) and other manufacturing (35.0 percent). The share of female labour with low education (class I to class V) i.e. LEdu1F in the total labour value added was highest in case of TCF activity (16.5 percent).

Table 7: Labour Value-Added Structure by Labour and Activity in 1999-2000

20 Aggregated activities	LEdu0M	LEdu1M	LEdu2M	LEdu3M	LEdu0F	LEdu1F	LEdu2F	LEdu3F	Labour share in total value added
1 Agriculture	39.4	21.9	13.8	6.1	10.0	5.7	2.6	0.6	52.6
2 Fishing	9.7	12.9	30.2	28.4	12.8	2.7	2.1	1.2	39.6
3 Forestry	47.8	30.9	13.7	7.1	0.1	0.3	0.0	0.0	33.9
4 FoodProcess	24.2	20.4	26.4	19.8	6.2	2.3	0.4	0.3	35.7
5 TCF	11.0	15.9	12.9	15.6	14.2	16.5	8.2	5.6	61.8
6 TobaccoProdt	21.5	18.2	22.9	17.6	12.8	5.5	0.8	0.6	18.0
7 WoodPaper	22.3	21.8	21.9	19.1	7.9	4.5	2.1	0.3	41.9
8 Chemicals	6.8	24.6	18.5	41.9	1.6	0.4	0.3	5.8	31.4
9 NonMtlPrd	41.1	25.3	14.9	8.7	7.9	1.7	0.5	0.0	33.6
10 Metals	6.7	33.9	32.8	26.0	0.3	0.2	0.0	0.0	49.4
11 MachinEqp	7.2	32.8	31.7	25.1	1.9	1.2	0.0	0.0	48.6
12 OthManufac	7.7	24.5	22.6	35.0	5.5	3.6	1.0	0.0	38.5
13 Construction	35.3	29.4	14.7	18.7	1.5	0.4	0.0	0.0	33.5
14 Utilities	4.4	11.2	12.4	66.7	0.2	0.0	0.0	5.1	23.0
15 MinigQuaring	4.4	11.2	12.4	66.7	0.2	0.0	0.0	5.1	43.4
16 Trade	21.5	26.2	26.0	23.9	1.7	0.3	0.3	0.1	43.5
17 Transport	47.8	25.3	13.1	12.8	0.4	0.3	0.0	0.3	40.5
18 HousingServ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19 PublicSvc	1.5	5.0	11.8	65.9	0.7	0.4	1.3	13.3	71.8
20 PrivateSvc	9.0	12.5	12.4	54.4	5.2	1.7	1.3	3.5	54.4
Total	22.3	19.2	16.5	28.7	5.4	3.2	1.8	2.9	44.1

Source: Author's calculations from the 1999-2000 input output table for Bangladesh (GOB, 2003b).

3 Theoretical Structure of the Bangladesh CGE Model

The theoretical structure of the core computable general equilibrium (CGE) model of the Bangladesh economy developed in this study is based closely on the Australian ORANI model. A complete description including the theoretical structure of the ORANI model is provided in Dixon *et al.* (1982). The Bangladesh model, like ORANI, is a single country comparative-static CGE model. It consists of 86 industries, 94 commodities and three primary factors of production: labour, capital and land. Its main characteristics are listed below:

3.1 Assumptions about production structure

Producers are assumed to be price takers who choose their inputs to minimise the cost of producing any given level of output subject to a constant return to scale

nested Leontief/constant elasticity of substitution (CES) production functions. CES functions allow substitution between: imported and domestic inputs; labour, capital and land; and occupations. Production functions are assumed to be weakly separable. No substitution is allowed between primary factors and intermediate inputs or between intermediate inputs of different classes. Substitution between imported and domestic inputs is modelled using Armington elasticities i.e. the Armington (1969) assumption that imports are imperfect substitutes for domestic supplies is adopted. Labour is disaggregated into eight groups according to gender and level of education. Figure A.1 located in Appendix A illustrates the structure of production.

3.2 Assumptions about investment demands

Investors are assumed to be price takers who minimise the cost of creating units of physical capital subject to nested CES production functions. Aggregate investment is normally exogenous, but its industrial composition depends on the relative rates of return across industries.

3.3 Assumptions about household demands

The representative household is assumed to maximise a nested Klein-Rubin/CES utility function subject to its aggregate budget constraints. Substitution is allowed between commodities and between sources of commodities using a nested Linear Expenditure System (LES)-CES demand system.

3.4 Export demands

Export demands are modelled by dividing all commodities into two groups: traditional and non-traditional. For an individual traditional export commodity, foreign demand is inversely related to that commodity's price and for the remaining collective non-traditional export commodities; foreign demand is inversely related to the average price of all collective export commodities.

3.5 Government demands

The level and composition of government consumption is exogenously determined.

3.6 Prices

Zero-pure-profit conditions and constant returns to scale imply that basic values of outputs are functions only of input prices. Basic prices of imports are the landed-duty-paid domestic currency prices. Purchasers' prices are the sum of basic prices, sales taxes, and trade and transport margins.

3.7 Market clearing

Commodity markets are assumed to be cleared. A common short-run assumption that real wage rates are fixed with labour in excess supply is adopted.

3.8 Identities defining macro variables

The model includes a number of identities defining macroeconomic variables (e.g. GDP, the trade balance, price indexes) as explicit aggregates of their microeconomic components.

The model is solved using the GEMPACK (General Equilibrium Modelling PACKage) computer software, developed by the Centre of Policy Studies and the Impact Project, Monash University, Australia (Harrison and Pearson, 1996). The main source of information for this study is the 1999-2000 input output table for Bangladesh (GOB, 2003b). The elasticity estimates used in this model are assigned on the basis of literature reviews.

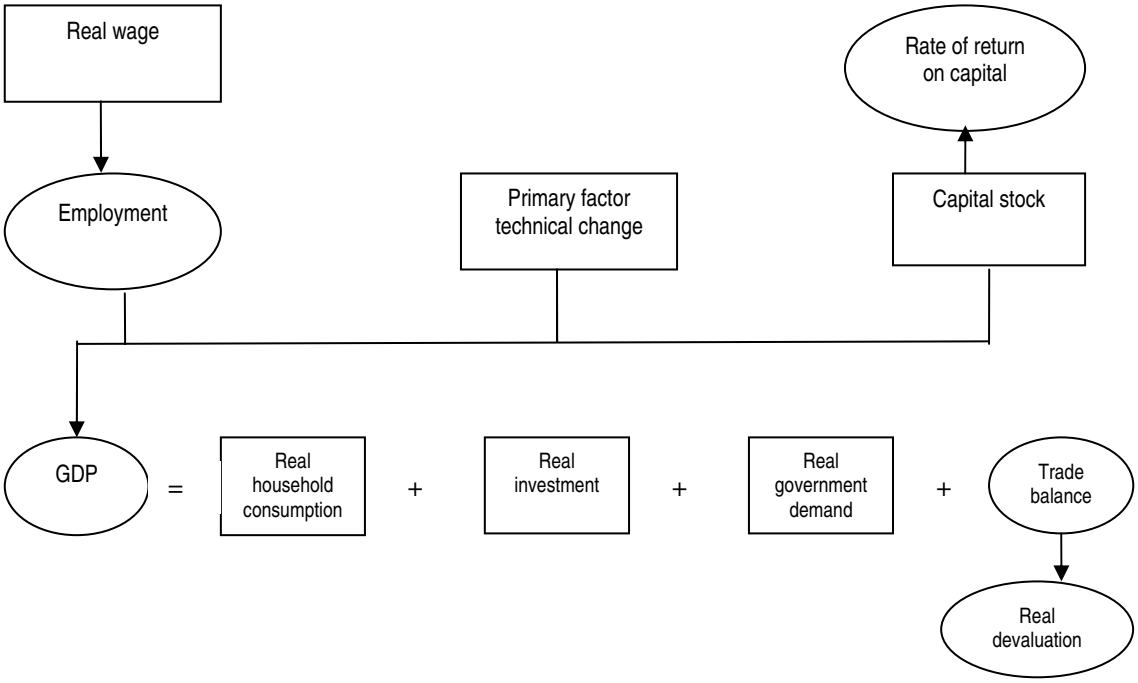
4 Simulations: Short-Run Effects of Removal of all Tariffs in Bangladesh

4.1 Simulation Assumptions

A simulation, in which all tariffs in the year 1999-2000 are completely removed, is carried out to assess the short-run economic impact of trade liberalisation in Bangladesh. The base year 1999-2000 and simulation experiment values of the tariff rates for the major commodities are presented in Table B.1 located in Appendix B. The key assumptions underlying the particular simulation are:

- the simulation relates to the short run – current capital stocks in each industry are held fixed, with rates of return to capital adjusting endogenously;
- real wages are held fixed, with employment adjusting in each industry;
- real domestic absorption is exogenous – real household consumption, real investment and real government demands are held fixed, allowing the trade balance to move; and
- finally, the nominal exchange rate is the numeraire.

Figure 1: Schematic Representation of the Short-Run Macroeconomic Environment



The constraints that our choice of assumptions place on the economy are important in determining relative price changes and therefore the responses of agents to the effects of removing tariffs in Bangladesh. Figure 1 presents a schematic representation of the short-run macroeconomic environment. In this figure, exogenous variables are depicted in rectangles and endogenous variables are depicted in ovals. The arrows indicate direction of causation between variables. On the supply-side of the macro economy, we have exogenised the capital stock, technology and the real wage. On the demand-side, aggregate household consumption, investment and government expenditure are held fixed, leaving the balance of trade as the endogenous in the national income identity.

4.2 Macroeconomic Effects

The results of some key macroeconomic variables are shown in Table 8. A back-of-the-envelope explanation of the economy-wide results is given in Appendix C. As we can see from Table 8, the removal of tariffs reduces the purchaser's prices of imported goods. This feeds into the consumer price index (CPI), which falls by 3.99 percent. With an assumption of fixed real consumer wages, the percentage change in the price paid for labour is equal to the percentage change in the CPI. Thus, average nominal wage rate falls by 3.99 percent. However, the prices received by producers fall by less than this amount (the GDP at factor cost deflator falls by only 2.67 percent. With the GDP at factor cost deflator falling by 2.67 and nominal wages falling by 3.99 percent, the real producer wage falls, causing an increased demand for labour and hence, an increase in the level of aggregate employment. An increased level of aggregate employment leads to more output from industries and therefore, a

higher aggregate output for the economy. With fixed capital stock, real GDP rises by a smaller percentage (0.79 percent) than employment (1.60 percent).

Table 8: Macroeconomic Impacts of Removing Tariffs

Description	Percentage changes
Real household consumption	0
Real investment	0
Real government demands	0
Export volume	8.91
Import volume CIF	2.70
Real GDP	0.79
Aggregate capital stock	0
Aggregate employment	1.60
GDP price index	-4.15
GDP at factor cost deflator	-2.67
Consumer price index	-3.99
Exports price index, local currency	-0.85
Real devaluation	4.33
Average nominal wage	-3.99
Average real wage	0
Terms of trade	-0.85
Aggregate tariff revenue*	-30704.78

*Note: *Aggregate tariff revenue is in ordinary changes in million Taka and all other macro results are percentage changes*

On the demand side of the economy, with fixed domestic absorption (real household consumption, government consumption and investment are held fixed), an increase in the real GDP must result in the trade balance moving toward surplus. Movements in the components of the international trade balance occur due to activity effects and relative price effects. Changes in domestic demand (with given prices) will tend to change the demand for imports – an activity effect. Hence with real GDP up, so too is the demand for imports (the aggregate import volume increases by 2.70 percent). The movement in the overall balance of trade towards surplus requires a change in international competitiveness (a change in domestic costs relative to foreign prices/costs in common currency terms) to induce an expansion in exports and to

dampen the increase in imports. The nominal exchange rate is the numeraire, hence the improvement in international competitiveness is achieved by a fall in the domestic price level (the GDP deflator falls by 4.15 percent). This leads to a large expansion in the aggregate export volume estimated at 8.91 percent. Taking exports and imports together, net exports (i.e. trade balance) improve significantly. The expansion in export volume causes the export price, and hence the terms of trade, to fall by 0.85 percent.

4.3 Effects on Output and Employment by Sector

Table 9 shows the estimated effects of the removal of tariffs on output and employment of selected industries. Table B.2 located in Appendix B presents the results for all 86 industries. In our analysis of the macro economy, we noticed a move towards trade surplus. We argued that the movement towards trade surplus required an improvement in international competitiveness i.e. a reduction in domestic costs relative to foreign costs/prices in common currency terms. We might think that the improvement in international competitiveness would favour the traded goods industries i.e. those industries that sell a large share of their output to foreigners and/or which compete in domestic markets with imports. Furthermore, industries that heavily rely on imported intermediate inputs would show positive growth in terms of output and employment generation.

The industries that are affected most favourably are jute fabrication (with an expansion in output of 6.85 percent and employment rises by 7.83 percent), baling (6.79 percent and 20.32 percent), public administration and defence (5.19 percent and 6.44 percent), knitting (5.14 percent and 8.63 percent), and ready made garments (hereafter, RMG) (4.73 percent and 7.92 percent). Except baling, all aforesaid

industries are highly export-oriented: the share of exports in the database account for 83 percent (RMG), 74 percent (knitting), 37 percent (jute fabrication) and 25 percent (public administration and defence). In general, export-oriented industries exhibit robust expansion in output and employment results. The expansion in baling output can be explained by the fact that the majority of output in this industry is supplied to the jute fabrication industry, which expanded tremendously.

Table 9: Effects of Removing Tariffs on Output and Employment of Selected Industries

Selected industries	Output	Employment
Jute fabrication	6.85	7.83
Baling	6.79	20.32
Public administration and defence	5.19	6.44
Knitting	5.14	8.63
Ready made garments	4.73	7.92
Jute cultivation	4.25	6.40
Cloth milling	3.38	6.66
Shrimp farming	2.67	6.07
Rural road	2.31	7.01
Toiletries manufacturing	2.20	5.22
Tea cultivation	2.13	4.61
Chemical industry	-0.90	-2.84
Sugarcane cultivation	-1.99	-4.22
Processed food	-2.05	-4.31
Cement manufacturing	-2.15	-6.16
Fruit cultivation	-2.24	-6.51
Sweetener industry	-2.26	-2.69
Fabricated metal products	-2.92	-5.76
Spice cultivation	-3.26	-7.14
Glass industry	-6.11	-11.45

Note: All figures are percentage changes.

While most industries expand when the tariffs are removed, there are some that contract. For instance, outputs and employment in the glass industry, spice cultivation, and fabricated metal product industry contract by 6.11 percent and 11.45 percent, 3.26 percent and 7.14 percent, and 2.92 percent and 5.76 percent respectively.

These industries are in the import-competing sector, because of the removal of tariffs, they lose market-share to imports.

4.4 Effects on Employment by Type of Labour

Our macroeconomic results show that a complete removal of all tariffs produces a 1.6 percent rise in the level of aggregate employment. The Bangladesh model, therefore, suggests that removal of tariffs is an effective means of preserving aggregate domestic employment. Decreased employment in the import-competing sector is more than offset by rises in employment elsewhere in the economy. As shown in Table 10, the employment by type of labour result indicates that expansion is felt most heavily in the export sector (export-related employment experiences the largest increase). In general, female workers experience a relatively higher increase in employment than male workers. The type of labour which experiences the largest increase in employment is the medium educated female workers (3.28 percent), followed by the low educated female workers (3.22 percent). The majority of the medium and low educated female workers are employed in RMG sector (32 percent of medium educated and 30 percent of low-educated) and knitting sector (9 percent of medium educated and 8 percent of low-educated), and these sectors experience robust expansion in employment (7.92 percent in RMG and 8.63 percent in knitting sector). As a result, both medium and low educated female workers experience the largest increase in employment. On the other hand, illiterate male workers, a majority (24 percent) of whom are employed in paddy cultivation sector experience a relatively smaller increase in employment (1.12 percent). Note that overall employment in paddy cultivation sector falls by 0.14.

Table 10: Effects of Removing Tariffs on Employment by Type of Labour

	Type of labour	Percentage changes
LEdu0M	Male labour with no education (no formal schooling)	1.12
LEdu1M	Male labour with low education (class I to class V)	1.25
LEdu2M	Male labour with medium education (class VI to class X)	1.34
LEdu3M	Male labour with high education (class XI and above)	1.97
LEdu0F	Female labour with no education (no formal schooling)	1.78
LEdu1F	Female labour with low education (class I to class V)	3.22
LEdu2F	Female labour with medium education (class VI to class X)	3.28
LEdu3F	Female labour with high education (class XI and above)	2.34

5 Conclusions

This study presents a large-scale comparative-static CGE model of the Bangladesh economy to examine the effects of trade liberalisation on macroeconomic indicators, as well as the effects on sectoral output and employment. In the short-run, a simulation, in which all tariffs are completely removed, is carried out. The simulation results indicate that a complete removal of all tariffs expands GDP and generates employment, which suggests that trade liberalisation has a short-run stimulatory effect on economic growth.

The industries that experience the greatest positive effects on their output and employment are the export-oriented industries. There are also positive effects on the suppliers to these industries. Lightly-protected industries that rely heavily on imported intermediate inputs exhibit robust expansion as they benefit from a cost reduction. On the other hand, highly-protected industries demonstrate contraction. The occupational pattern of the employment results indicates that expansion is felt most heavily in the export sector (export-related occupation experiences the largest increase).

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APPENDIX A

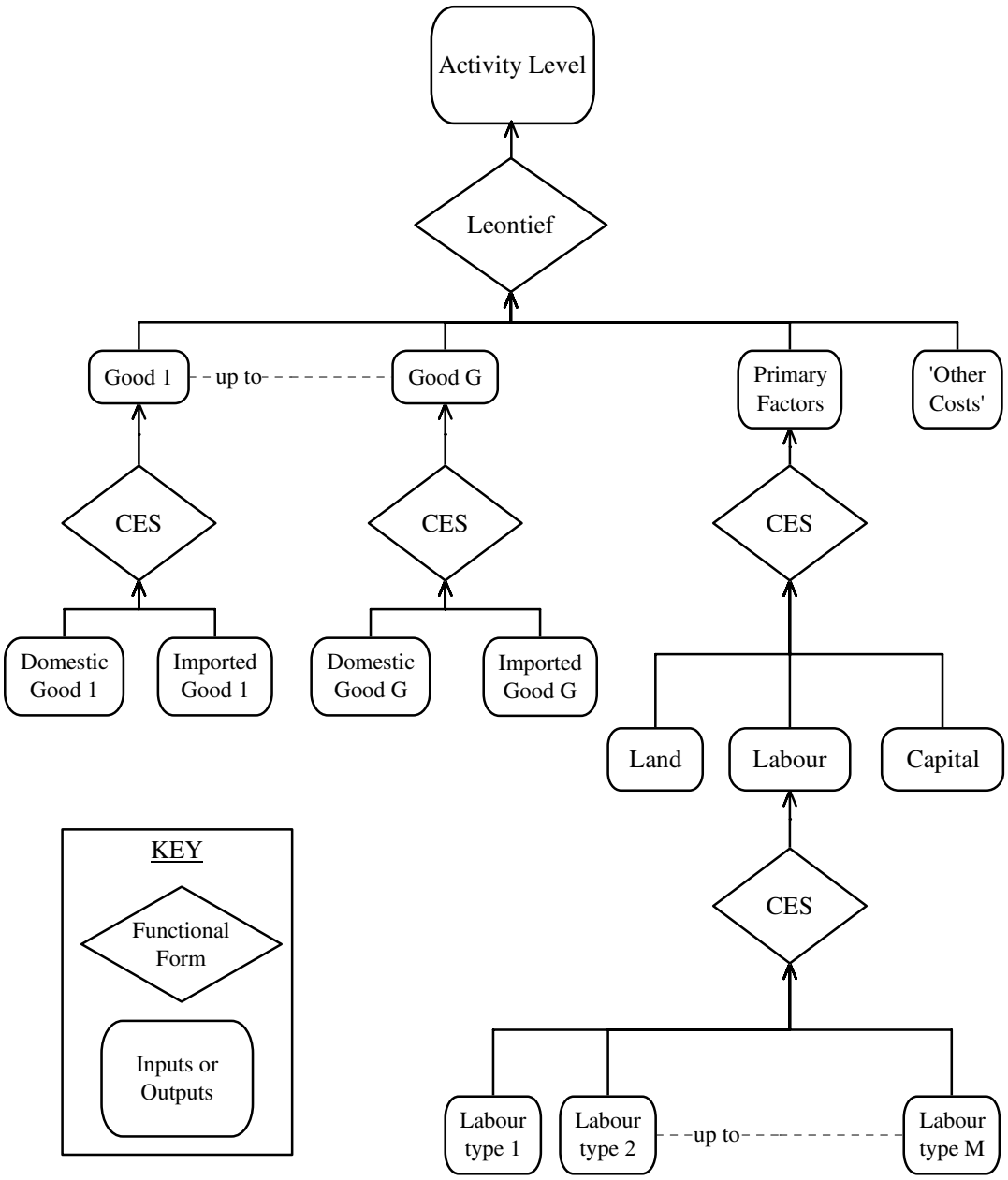

Figure A.1: Structure of Production

APPENDIX B

Table B.1: Tariff Rates for Base Year and Simulation Experiment

Major commodities	Base year 1999-2000			Simulation tariff rates
	Import values	Tariff revenues	Tariff rates	
Petroleum product	48276	9454	19.58	0.00
Machinery	82195	4570	5.56	0.00
Edible non-edible oil	41404	2290	5.53	0.00
Transport equipment	22781	1852	8.13	0.00
Fabricated metal products	11900	1579	13.27	0.00
Milk and fat	4631	1112	24.01	0.00
Miscellaneous industry products	17734	1097	6.19	0.00
Cement	7034	1003	14.26	0.00
Iron steel basic	18916	959	5.07	0.00
Pulp paper and board	12981	888	6.84	0.00
Wheat	21958	682	3.11	0.00
Fruits	3022	526	17.41	0.00
Basic chemicals	6647	521	7.84	0.00
Yarn	13808	450	3.26	0.00
Processed food	3055	449	14.70	0.00
Sugar gur molasses	2856	439	15.37	0.00
Glass products	2558	365	14.27	0.00
Vegetables	9283	340	3.66	0.00
Mining and quarrying	2991	221	7.39	0.00
Mill cloth	11272	212	1.88	0.00
Oil seeds	4635	207	4.47	0.00
Toiletries	1666	180	10.80	0.00
China pottery	819	173	21.12	0.00
Spices	792	149	18.81	0.00
Chemical products	2876	132	4.59	0.00
Fish sea food	880	122	13.86	0.00
Tobacco	1248	121	9.70	0.00
Rice flour bran feed	6132	96	1.57	0.00
Total	**407986**	**30706**	**7.53**	**0.00**

Note: Import values and tariff revenues are in million Taka and tariff rates are in percentages.

Table B.2: Effects of Removing Tariffs on Output and Employment of all 86 Industries

Industry	Output	Employment
Paddy cultivation	-0.08	-0.14
Wheat cultivation	-0.11	-0.18
Other grain cultivation	-0.09	-0.19
Jute cultivation	4.25	6.40
Sugarcane cultivation	-1.99	-4.22
Potato cultivation	-0.05	-0.11
Vegetable cultivation	0.47	1.06
Pulses cultivation	-0.25	-0.61
Oilseed cultivation	-0.89	-1.61
Fruit cultivation	-2.24	-6.51
Cotton cultivation	1.45	4.15
Tobacco cultivation	-0.19	-0.39
Tea cultivation	2.13	4.61
Spice cultivation	-3.26	-7.14
Other crop cultivation	-0.10	-0.22
Livestock rearing	-0.95	-2.17
Poultry rearing	-0.11	-0.42
Shrimp farming	2.67	6.07
Fishing	-0.12	-0.32
Forestry	-0.31	-0.90
Rice milling	0.01	0.07
Grain milling	-0.48	-2.44
Fish process	0.29	1.65
Oil industry	-0.49	-2.26
Sweetener industry	-2.26	-2.69
Tea product	-0.83	-1.37
Salt refining	-0.51	-0.77
Food Process	-2.05	-4.31
Tanning and finishing	1.38	4.50
Leather industry	1.30	3.89
Baling	6.79	20.32
Jute fabrication	6.85	7.83
Yarn industry	1.36	1.92
Cloth milling	3.38	6.66
Handloom cloth	-0.32	-0.43
Dyeing and bleaching	-0.07	-0.11
Ready made garments (RMG)	4.73	7.92
Knitting	5.14	8.63
Toiletries manufacturing	2.2	5.22
Cigarette industry	0.21	1.55
Bidi industry	0.12	0.41
Saw and plane	-0.20	-0.47
Furniture industry	0.30	0.71
Paper industry	-0.44	-1.52
Printing and publishing	0.52	0.85

...Table B.2 continues

Table B.2 continued

Industry	Output	Employment
Medicines	0.49	1.14
Fertiliser industry	0.64	2.82
Basic chemical	0.58	1.26
Petroleum refinery	0.08	0.41
Earth ware industry	-0.06	-0.27
Chemical industry	-0.90	-2.84
Glass industry	-6.11	-11.45
Clay industry	0.32	0.75
Cement manufacturing	-2.15	-6.16
Basic metal manufacturing	-0.83	-1.65
Metal manufacturing	-2.92	-5.76
Machinery and equipments	0.24	0.36
Transport equipments	0.39	1.52
Miscellaneous industry	1.54	4.11
Urban building	0.38	1.07
Rural building	0.26	0.84
Power plant building	0.12	0.56
Rural road building	2.31	7.01
Port road railway building	1.87	3.22
Canal dyke other buildings	-0.72	-1.26
Electricity and water generation	0.37	1.63
Gas extraction and distribution	-0.14	-0.49
Mining and quarrying	-0.35	-0.80
Wholesale trade	1.21	2.80
Retail trade	0.34	0.79
Air transport	1.21	1.87
Water transport	1.21	4.48
Land transport	1.21	3.78
Railway transport	1.21	1.47
Other transport	1.99	3.88
Housing service	0.00	-1.62
Health service	-0.48	-1.00
Education service	0.01	0.01
Public administration and defence	5.19	6.44
Bank insurance and real estate	0.93	1.47
Professional service	0.83	2.19
Hotel and restaurant	0.65	1.24
Entertainment	0.06	0.11
Communication	1.70	3.32
Other services	0.19	0.24
Information technology and e-commerce	1.40	2.73

Note: All figures are percentage changes.

APPENDIX C

Back-of-the-envelope explanation of economy-wide tariff cut results

In section 4 we have briefly analysed the economy-wide results of the tariff removal simulation. In this appendix we seek to illustrate with a one-sector model, why the Bangladesh model gives the key result that a broad-based tariff cut leads to an economy-wide increase in activity and employment. We approach this task by developing an equation which gives a rough approximation to the form of the short-run supply function which underlies an industry's output responses under our chosen simulation environment.

We proceed by formulating an equation covering industry demands for primary factors. We assume that limited substitution possibilities between different primary factor inputs are governed by a constant elasticity of substitution (CES) function. Specifically we assume that the industry chooses its primary factor inputs $X_i \ \ (i = 1,2)$ to minimise the cost $\sum_i P_i X_i$ of producing a given bundle of effective primary factor inputs Z, subject to the CES production:

$$Z = \left(\sum_i \delta_i X_i^{-\rho} \right)^{-1/\rho} \tag{C.1}$$

The associated first order conditions are:

$$\frac{\partial L}{\partial X_i} = P_i + \frac{\Lambda}{\rho} \left[\sum_i \delta_i X_i^{-\rho} \right]^{-1/\rho - 1} \left(-\rho \delta_i X_i^{-\rho - 1} \right) = 0 \tag{C.2}$$

Or, solving for P_i

$$P_i = \Lambda \delta_i X_i^{-(1+\rho)} \left[\sum_i \delta_i X_i^{-\rho} \right]^{-(1+\rho)/\rho} \tag{C.3}$$

$$\frac{\partial L}{\partial \Lambda} = \left[\sum_i \delta_i X_i^{-\rho} \right]^{-1/\rho} - Z = 0 \tag{C.4}$$

Or, solving for Z

$$Z = \left[\sum_i \delta_i X_i^{-\rho} \right]^{-1/\rho} \tag{C.5}$$

Substituting from (C.5) into (C.3) we obtain:

$$P_i = \Lambda \delta_i X_i^{-(1+\rho)} \left[Z \right]^{(1+\rho)} \tag{C.6}$$

Or, solving for X_i

$$X_i = \left[\Lambda \delta_i \right]^{1/(1+\rho)} \left[P_i \right]^{-1/(1+\rho)} Z \tag{C.7}$$

Transforming (C.7) to percentage changes we get:

$$x_i = \lambda /(1+\rho) - p_i /(1+\rho) + z \tag{C.8}$$

Or

$$x_i = \sigma\lambda - \sigma p_i + z \tag{C.9}$$

where

$$\sigma = 1/(1+\rho) \tag{C.10}$$

The percentage form of (C.5) is

$$z = 1/\rho \left[\sum_i S_i \rho x_i \right] \tag{C.11}$$

Or

$$z = \sum_i S_i x_i \tag{C.12}$$

where

$$S_i = \frac{\delta_i X_i^{-\rho}}{\sum_k \delta_k X_k^{-\rho}} \tag{C.13}$$

Multiplying both sides of (C.3) by X_i we get:

$$P_i X_i = \Lambda \delta_i X_i^{-\rho} \left[\sum_i \delta_i X_i^{-\rho} \right]^{-(1+\rho)/\rho} \tag{C.14}$$

Hence

$$\sum_k P_k X_k = \Lambda \delta_1 X_1^{-\rho} \left[\sum_i \delta_i X_i^{-\rho} \right]^{-(1+\rho)/\rho} + \ldots + \Lambda \delta_n X_n^{-\rho} \left[\sum_i \delta_i X_i^{-\rho} \right]^{-(1+\rho)/\rho} \tag{C.15}$$

Therefore

$$\frac{P_i X_i}{\sum_k P_k X_k} = \frac{\Lambda \delta_i X_i^{-\rho} \left[\sum_i \delta_i X_i^{-\rho} \right]^{-(1+\rho)/\rho}}{\Lambda \left[\sum_i \delta_i X_i^{-\rho} \right]^{-(1+\rho)/\rho} \left(\delta_1 X_1^{-\rho} + \ldots + \delta_n X_n^{-\rho} \right)} \tag{C.16}$$

Or $$\frac{P_i X_i}{\sum_k P_k X_k} = \frac{\delta_i X_i^{-\rho}}{\sum_k \delta_k X_k^{-\rho}} = S_i \qquad \text{(C.17)}$$

i.e. the S_i of (C.17) turn out to be cost shares.

To get rid of λ, substituting (C.9) into (C.12) we obtain:

$$z = \sum_i S_i(\sigma\lambda - \sigma p_i + z) \qquad \text{(C.18)}$$

Or, solving for λ $$\lambda = \sum_i S_i p_i \qquad \text{(C.19)}$$

since $\sum_i S_i = 1$.

Substituting λ from (C.19) back into (C.9) we obtain the input demand functions:

$$x_i = z - \sigma\left(p_i - \sum_i S_i p_i\right) \qquad \text{(C.20)}$$

We continue by restating a simplified version of equation (C.20) assuming here only two primary factors, labour and capital.

$$l = z - \sigma(w - S_L w - S_K r) \qquad \text{(C.21)}$$

$$k = z - \sigma(r - S_L w - S_K r) \qquad \text{(C.22)}$$

where l and k are the percentage changes in the demand for labour and capital respectively by a representative industry, z is the percentage change in the activity level of the representative industry, w and r are the percentage changes in the prices paid for labour and the rental of capital respectively by the industry, σ is the parameter reflecting the degree of substitutability between labour and capital and S_L and S_K are primary factor shares.

We can rewrite (C.21):

$$l = z - \sigma[w(1 - S_L) - S_K r] \qquad \text{(C.23)}$$

Or $$l = z - \sigma S_K(w - r) \qquad \text{(C.24)}$$

For the short-run $k = 0$ and (C.22) becomes:

$$z = \sigma(r - S_L w - S_K r) \tag{C.25}$$

Or $$S_K r = -z/\sigma + r - S_L w \tag{C.26}$$

Substituting (C.26) for the term $S_K r$ in (C.24):

$$l = z - \sigma\left(S_K w + z/\sigma - r + S_L w\right) \tag{C.27}$$

Or $$l = -\sigma\left(w - r\right) \tag{C.28}$$

We can also rearrange (C.25) to obtain:

$$z = \sigma r - \sigma S_L w - \sigma(1 - S_L) r \tag{C.29}$$

Or $$z = -\sigma S_L (w - r) \tag{C.30}$$

Dividing (C.28) by (C.30) we get:

$$l/z = 1/S_L \tag{C.31}$$

Or $$l = z/S_L \tag{C.32}$$

Accounting for all costs in creation of primary factor input bundle:

$$PZ = P_L X_L + P_K X_K \tag{C.33}$$

The percentage form of (C.33) is

$$p + z = S_L(p_L + x_L) + S_K(p_K + x_K) \tag{C.34}$$

Using (C.12) to substitute for z in (C.34) we obtain:

$$p + S_L x_L + S_K x_K = S_L(p_L + x_L) + S_K(p_K + x_K) \tag{C.35}$$

Or, solving for p $$p = S_L p_L + S_K p_K \tag{C.36}$$

Or $$p = S_L w + S_K r \tag{C.37}$$

where p is the basic price of output from the industry.

Rearranging (C.28) to solve for r which we then substitute into (C.37), we obtain:

$$p = S_L w + S_K (w + l/\sigma) \tag{C.38}$$

Or $$p = S_L w + (1 - S_L) w + (1 - S_L) l / \sigma \quad \text{(C.39)}$$

Or $$p = w + (1 - S_L) l / \sigma \quad \text{(C.40)}$$

Or $$l = \sigma (p - w) / (1 - S_L) \quad \text{(C.41)}$$

Using (C.32) to substitute for l in (C.41) we obtain the short-run supply function:

$$z = \sigma (p - w) S_L / (1 - S_L) \quad \text{(C.42)}$$

Therefore, it can be seen from (C.42) that the output response of an industry is dependent on the primary factor substitutability, the share of non-fixed factors in total factor costs and the difference between the percentage changes in output price and labour costs.

For the purpose of explaining the output response of the whole economy to the tariff shock, let us assume that the economy has only one industry and the output of that industry is both exported and sold domestically. Thus we now take z in (C.42) to cover the supply response of the whole economy.

Whether the economy's output (and employment) is expected to expand or contract as a result of the tariff cut will now depend solely on p and w. An assumption of our tariff experiment is full wage-indexation. Thus, w is equal to the percentage change in the consumer price index, p_c, which can be written as:

$$p_c = S_d^c p + (1 - S_d^c)(p_m + t) \quad \text{(C.43)}$$

where p_m is the percentage change in the basic price of imports, t is the percentage change in the power of the tariff (i.e. one plus the tariff rate) and S_d^c is the share of domestic commodities in total household consumption.

In our experiment we assumed that $p_m = 0$ and we can also assume that the following approximately holds:

$$p = p_x = 0 \quad \text{(C.44)}$$

where p_x is the Bangladeshi currency 'free on board' (f.o.b) export price. That is, we assume that the export price sets the domestic price and we further assume that Bangladesh is too small a country for a change in its tariff rate to have any effects on the terms of trade. Thus from (C.43) we have:

$$p_c = (1 - S_d^c)t \qquad \text{(C.45)}$$

and since $t < 0$, this means $p_c < p$ and therefore $w < p$.

Therefore, on the basis of (C.42) we would expect an expansion in economy-wide output as a result of tariff cut, and on the basis of (C.41) also an expansion in economy-wide employment.