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Research Article

Competitive capacity and export potential of agro-processing industries under the trade liberalization regime of Bangladesh

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Abstract

The GDP share of the Bangladesh economy is declining in agriculture while escalating in manufacturing and services through export oriented industrialization. In this progression, agribusiness as well as agro-processing industries is playing a vital linkage between agriculture and industry, which is gradually receiving increased attention from policy makers and investors seeking to boost the economy through more agro-based industrialization. Although Bangladesh economic growth is export led, the agro-processing sector still does attract a significant share of exports due to the lack of adequate productivity and competitive capacity in both the domestic and international markets. This study seeks to assess the position of this sector and suggest the best policy reform options to increase domestic competitiveness and enhance export orientation of the agro-processing sector. Through the application of computable general equilibrium models for Bangladesh, three policy reform scenarios are evaluated i.e., liberating trade or increasing productivity, or a combination of these. The results suggest that the third scenario, that is opening trade with increased productivity of the agro-processing sector, is the best choice of policy reform to increase competitive capacity of domestic output, export potentiality of agro-processing industry, household welfare and macroeconomic gain for the country.

Keywords: poverty reduction strategy, economic scenarios, policy, CGE.

Introduction

The socio-economic development process of Bangladesh is progressing towards the target of sustainable Millennium Development Goals (MDG) by following multidimensional pro-poor policies. The current track of policy reforms are under the Poverty Reduction Strategy Paper (PRSP) where the central point of the target is poverty reduction with the circle of opening the economy towards keeping pace with the globalization. The expansion of export oriented manufacturing sector is one of the major pathways to reach the target of MDG through PRSP. This expansion through private investment (FDI or local) in agro-based small medium enterprise (SME)

can help to increase the employment and income of the poor [1]. It has been observed that the economy has been gradually shifting from import substitute industrialization (ISI) to export oriented industrialization (EOI) during the 1980's and 90's. These industrial reforms were carried out under sectoral adjustment programs (SAP) which were conducted by structural adjustment loans (SALs) of the World Bank and structural adjustment facility (SAF) program of International Monetary Fund (IMF). These reforms contributed significantly to move the GDP share from agriculture to a manufacturing and service based economy. This is apparent from comparing the shares of GDP. In 1974 they were 59.26% in agriculture, 7.19% in manufacturing and 33.44% in the service sector, while in 2008, the agriculture sector share (20.87%) in GDP shrank and the share of industry (17.77%) and service (61.36%) sectors expanded. Although the direct GDP contribution from agriculture is declining, the indirect contribution is escalating due to strengthening forward and backward linkages with manufacture and service sectors through agro-based industry [2].

Bangladesh's economic growth is export-led and has a long run equilibrium relation, especially with the manufacturing export [3, 4]. It is also acknowledged that the major determinants of export growth were the multi fibre agreement (MFA) trade policy of the World Trade Organization (WTO) and reduced anti-export bias through exchange rate devaluation. However, after the abolition of MFA in 2005, the country's ready-made garment (RMG) sector and consequently other export oriented sectors have fallen in great competitively. Moreover, this international export market competitiveness is hindered by factors such as productivity; economic governance; corruption; poor infrastructure; high cost of finance [5]. Bangladesh has the deep rooted needs of skilled and well-trained labour to accelerate productivity and global competitiveness [6]. To keep the increasing trend of export growth, it is suggested that policy initiatives should be forward not only by exchange rate management but also increasing competitiveness through higher productivity by improving labour efficiency and the introduction of new technology in industry [7]. In the globalization process, competitiveness of agro-based industry in the international and domestic market is a crucial factor to reap the benefit of WTO initiatives to increase exports to the world and increase the agriculture sector's contribution to the GDP of the Bangladesh economy. Selim and Kalirajan [8] revealed that the agro-processing industries have strong potential to increase their output through increased TFP. Because they do not exploit the technology fully means they are less efficient in using technology and also inefficient in choosing proper technology for technical progress.

This paper confronts a computable general equilibrium (CGE) model of the Bangladesh economy to quantify and evaluate the impact of policy trade off scenarios comprising opening more trade opportunities and improved productivity. This study appraises and suggests the best effective policy reform options to increase competitive capacity for output in the domestic market and increasing the export potential of the agro-processing sector. This in depth economy wide CGE model also includes the extent of agro-processing sectors policy reform impact on other sectors output, price, factor income, household income, welfare and the macro economy as well.

Section 2 contains a synoptic description of the trade policy and productivity of the agro-processing industry in Bangladesh. Section 3 briefly outlines the methodology through discussing the database, CGE modelling and analytical blocks of the model. Section 4 spells out three scenarios that are undertaken for counterfactual policy simulation by the CGE model. Section 5 discusses the results of the simulation. Section 6 evaluates and compares the scenarios for the best choice. The paper ends with a summary and brief concluding remarks in Section 7.

Trade Policy and Productivity of Agro-processing Sector

Through implementation of the economic policy reform by the SAP from 1975, the country has been moving from an inward looking regime towards a more liberalized market oriented regime. Bangladesh initiated trade liberalization processes moderately since the 1980's, then more swiftly and widely in the 1990's. The gradually liberalized trade policy resulted in a boost to import growth of 9% per annum and export growth of 11% per annum within the period of 1973 to 2007. The reflection of import trade policy reform can be explained through the reduction of the maximum rate of tariff from 350% to 25% within the years 1991 to 2006. The average protective tariffs are currently 26.5%, whereas average industrial tariffs are 25.3% and agricultural tariffs are 32.6%. The degree of openness increased steadily and stood at 41% in year 2007, compared to 14% in 1974. Other openness measuring indicators like export propensity and import penetration also increased gradually and stood at 18% and 22% respectively in 2007.

Increasing domestic liberalized trade is the challenging issue for the domestic market economy of Bangladesh for raising SME's capacity to compete with more market-based foreign rivals. To increase the challenge facing capacity, the industries need to modernize themselves through increasing technical efficiency and technological progress by equipping themselves with up-to-date technology and knowledge-based production processes. Sectors are facing high competition not only in domestic markets but also in the export markets. Considering product and market over the last two decades, exports were highly concentrated on the ready-made garment sector, which showed the vulnerability and permanent weakness of the export sector. The policy debate is that, to minimize the loss of export market access in any circumstances, the export policy should be diversified through export orientation of new products and new sectors [9]. The trade and industry policies of Bangladesh are thus moving towards product diversification and market expansion. In this context, expansion of SME's through agro-processing industry is considered as a priority sector.

The food processing sector accounts for 2% of GDP of the Bangladesh economy. In the period 1996-2007, the production growth rate of agro-based industry was 5%. Agro-processing sector accounts for 22% of total manufacturing production and engages 20% of the national labour force. The average annual growth rate for export of all food products was 10% and imports 15% in the period 1991-2007. Though the number of processed food industries (5,737 units) are high, the TFP growth rate is negligible or even negative [8, 10, 11]. Salim [11], also reported that the annual average growth rate was marginal ranging from -0.95% to 3.65% in the post liberalization regime (1992-97), compared to sluggish TFP growth ranging from 0.42% to 3.02% in the pre-liberalization period (1986-92). It was also found significant that input growth contributed highly to output growth. Fernandes [12] showed that in 1999–2003 the industry weighted average TFP growth was 2.73% in agro-processing industries. The firm TFP growth rate was –0.10% in 1999-2000 and 3.12% in 2002-2003 respectively. This study also revealed that that enterprises with more integration with globalization such as foreign investment, and export oriented firms had higher TFP, small and medium sized firms were more productive than large firms and advanced technology user firms with sufficient absorption capacity had an increase of TFP. Goedhuys, *et al.* [13] pointed out that the productivity of the food processing industry is strongly influenced by the quality of management and foreign ownership.

Analytical Framework

General equilibrium model approach

This study has applied the CGE model which was derived from the model developed by Dervis, *et al.* [14], and was further standardised by Lofgren, *et al.* [15], through the incorporation of additional features. The model originally followed the neoclassical approach but later structuralist features [16] were included to give particular emphasis to developing country economic

characteristics. The developed model explicitly takes into account the key features of the Bangladesh economy and is numerically calibrated from the micro social accounting matrix (SAM) of Bangladesh for the year 2005.

The model is comparatively static in nature and the time frame is termed "short run equilibrium". In this short run model, it is assumed that there is a full adjustment in all economic sectors when the equilibrium changes from one to another. In this CGE model, Bangladesh is assumed to be a "small country", which indicates that world prices are given means treated as exogenous variables. This model has the assumption of a perfect competitive market and constant returns to scale of production. Based on the static nature, investment is assumed as a macro demand variable but is not considered as capital formation for sectors within the simulation. The model is based on Walrasian equilibrium which determines only the relative prices. Consumer price index is considered as model *numéraire* with the value fixed at one [17].

Social accounting matrix (SAM)

The foremost database that captures the CGE model is presented in the form of SAM. A SAM is a squared matrix constructed by the information that quantifies the flow of payments and receipts for production and consumption by the industries, factors, households and other institutions at a fixed period of time. The data used for this study is primarily derived from the macro social accounting matrix (SAM) of Bangladesh for the year 2005 [18], shown in Table 1. The main sources of information for the micro SAM are (a) 2000 SAM prepared by Arndt, *et al*. [19]; (b) Bangladesh Economic Review [20]; (c) export receipts and import payments; and (d) national income estimated by BBS [21].

Bangladesh SAM is articulated into six major accounts, which are described as: industry activity of sector, commodities of sector, factors of production, savings and investment, tax and tariff, institutions (household, enterprise, government and rest of the world). Both the industry activities and commodities are disaggregated into 13 different sectors. Among them, 7 sectors are considered as agricultural sectors (paddy, grain, other crops, livestock, poultry, shrimp, other fishes), 5 sectors are considered as manufacturing sectors (milled grain, processed food, knitting and garments, textile and clothing, and other industries) and the remainder is an aggregated sector including service, construction and government utilities that make up the service and utility sector. Factors of production especially labour are disaggregated into four categories such as agricultural unskilled labour, agricultural skilled labour, non-agricultural unskilled labour and non-agricultural skilled labour. Households are disaggregated into eight household groups i.e., landless household, marginal farm household, small farm household, large farm household, non-farm poor household, non-farm non-poor household, low and medium educated household and high educated household.

In this study, the processed food and milled grain sectors are jointly included in the agro-processing sector for convenient discussion. The percentage of distributional share among the sectors is presented in Table 2 wherein it is identified that the share of processed food is 2.17% and milled grain is 2.4% of total value added of all sectors. In terms of total imports, the share of processed food is 6.78% and milled grain is 2.13%. For total exports, the share of processed food is 6.95%, while milled grain does not have a share in the export account. Domestic consumption is comprised of 3.17% imported milled grain and 15.94% processed food. 11.13% of the production of processed food is exported.

Table 1. Social accounting matrix (SAM) of Bangladesh Year 2005, Billion Taka.

Accounts	Ind.	Comm.	V.A.	H.hold	D. Tax	Tariff	Ent.	S. Invest.	Govt.	ROW	Total
Industry		7273									7273
Commodity	3742			3003				909	205	508	8368
Value Added	3531										3531
Household			2240				1217		165	216	3838
Domestic Tax		90									90
Tariff		151									151
Enterprise			1291						54		1344
Savings Invest				828			86	234	-138	134	1144
Government				8	90	151	42				290
ROW		854							4		858
Total	7273	8368	3531	3838	90	151	1344	1144	290	858	

Source: Khondker [18].

Table 2. Sectoral share (%) in economy of Bangladesh SAM 2005.

Sectors	Value Added	Domestic Prod.	Import	Export	Inter. input	Consumption	Employment
Paddy	5.80	5.15	0.00	0.00	4.53	4.82	4.90
Grain	0.40	0.45	2.46	0.00	0.50	0.70	0.58
Other crop	7.24	6.87	3.21	1.11	6.53	6.75	2.96
Livestock	2.04	1.89	0.07	0.00	1.75	1.78	2.44
Poultry	0.42	0.46	0.00	0.00	0.50	0.43	0.16
Shrimp	0.88	0.93	0.00	4.52	0.97	0.57	0.46
Other fish	3.49	3.50	0.01	0.56	3.50	3.24	1.20
Milled Grain	2.40	7.64	2.13	0.00	12.68	7.41	0.55
Processed Food	2.17	4.37	6.78	6.95	6.39	4.68	2.10
Knit & Garments	3.55	6.08	1.90	76.20	8.51	0.91	3.03
Textile & Cloth	2.55	4.65	17.55	0.77	6.67	6.30	4.28
Other Industry	7.12	11.64	65.89	9.89	15.83	19.00	6.18
Service & Utility	61.92	46.38	0.00	0.00	31.63	43.42	71.16
Total	100	100	100	100	100	100	100

Source: Bangladesh SAM 2005

Model characteristics

The model sketches the behavioural linkages of the actors in the economy through simultaneous linear and nonlinear equations. The details of model equations and variables are discussed by Lofgren, *et al*, [15]. Model specification of production, trade and consumption behaviour are discussed briefly.

Commodity production activity

In the model the industry sector is separated by the production activities (producer) and commodity market. Aggregate domestic or marketed output of a commodity is a constant elasticity of substitution (CES) aggregation function of different activities of the produced commodity. Each activity produces output in assumption of profit maximization subject to the technology. Production technology to produce output of each activity is modelled in two levels. In the top level of the technology nest, output of each activity is a linear combination of aggregate intermediate input and

aggregate value added with a fixed coefficient. So the demand for aggregate value added and aggregate intermediate inputs are determined by a standard Leontief formulation. This implies zero substitutability between value-added and aggregated intermediate inputs in production. At the bottom level of the technology nest, quantity of value added is a CES function of the optimum contribution of disaggregated primary factors (land, labour and capital) in a given technology which permits substitution among the factors.

International trade and domestic market

To capture the cross hauling phenomenon, it is assumed that there is imperfect substitution between the export and domestic sale of domestic output and also between the imported and domestically sold domestic output. Suppliers decide to supply sectoral domestic output by allocating between exports and domestic sales, which is determined on the assumption that domestic suppliers maximize sales revenue subject to imperfect transformability between these two alternative ends. This allocation is captured by constant elasticity of transformation function (CET) introduced by Powell and Gruen [22]. The model assumes that final demand by the domestic consumer is cost minimizing subject to the imperfect substitutability between the imported and domestically sold commodities, which together are defined as a bundle of composite goods. The supply of the composite commodity is defined by the CES trade aggregation function [23, 24], which is also known as the "Armington" function.

Institutions and welfare

In the model the institution is disaggregated by household, enterprise, government and rest of the world (ROW). Household is considered as the main supplier of the factors of production and receiver of the factor payments. Household income is also sourced through receipts as transfers from government, transfers from the rest of the world and surplus from enterprise. Household expenditure comprises the consumption of commodities, income tax and private savings. Households are assumed to be price takers and maximize their utility through "Stone-Geary" Klein-Rubin/CES utility function [25], subject to an aggregate consumption expenditure constraint equal to income. With the derived utility and change expenditure, the welfare gain or loss of household are estimated through using the equivalent variation (EV) method which has been developed by Hicks [26]. Conceptually, EV measures the percentage change (difference between the base and simulation) of income that is needed or sacrificed to get the new utility through the measuring of consumption expenditure at the base level income and price.

Enterprise plays a role as a channel amongst the factors of production and institutions (household, government). Enterprise receives income from the factors of production and transfers from government. It allocates income to the household as surplus, as direct tax to the government and as savings. In this model, the government is not regarded as an optimizer, but rather is treated as an explicit agent that captures the macro balance of the circular flow of the economy. Government receives revenue from various taxes such as: direct tax of household and enterprise income; duties on imported goods; and indirect taxes on goods and services. Public expenditure is used for the services and utilities, transfer to household and enterprise and the rest of the world. The ROW receives income by exporting commodities and government investment abroad. The ROW transfers back that income to the recipient national economy through the payments for imports, remittances and foreign investment.

System constraints

The "closure rules" of the model are broadly and principally grouped by "Johansen closure" and "neoclassical closure" tradition. These two closure groups are considered to understand the sensitivity of results that may vary due to change of closure rules. The Johansen closure is considered as appropriate for a static economy and neoclassical closure is for sensitivity check. In both the closure groups, the chosen factor market closure for labour is specified by the full

employment and unemployment of labour. It is assumed that agricultural and non-agricultural skilled labour and agricultural unskilled labour are fully employed and mobile. Supply of labour is fixed and the economy wide wage is flexible to adjust to the flexible demand for labour. In the context of Bangladesh, there is unemployment of non-agricultural unskilled labour category; supply and demand of that type of labour is flexible to adjust to the fixed economy wide wage variables [19]. In the Johansen closure group, it is assumed that capital is fully employed and activity specific, which in turn assumes that the economy wide rent of capital and demand are fixed and supply of capital is a flexible variable subject to adjustment. In the neoclassical closure group, the capital is assumed as fully employed and mobile across the sectors, which also assumes that the supply of capital is fixed and the rent of capital is the adjusting variable to equilibrate the market.

Due to change of the macroeconomic adjustment variables the definition of equilibrium and closure rules varies. The closure rules for macro system constraints are differentiated by three macroeconomic balances, such as savings-investments balance, government fiscal balance and external balance. The definition of Johansen and neoclassical closure groups are mainly based on two different saving investment balance closure rules. The Johansen closure [27] is investment driven and is more appropriate for short run static effect. Neoclassical closure is savings driven which is fundamental to the Walrasian model and appropriate for long run static effect. In the investment-driven closure, investments are fixed and savings are determined by the base year savings rate of selected institutions which is multiplied by a scalar. In the savings-driven closure, investments are determined by the household, government and foreign savings where savings rates are fixed. Under government fiscal balance closure rules, it is assumed that government savings means the government balance is free to adjust, which is achieved when direct tax rate for non-government institutions is constant. Government consumption remains unchanged and on the contrary government revenue may be changed by shocks. The external balance closure rule assumes that foreign savings means current account balance is fixed and foreign exchange rate adjusts with that fixed trade balance. In summary, it is understood that the Johansen closure group represents the short term adjustment closure rules. On other hand the neoclassical closure group reflects the medium or long term adjustment closure rules.

Policy Reform Scenarios

The main outlook of this paper is to find out the best policy reform scenarios by which the agro-processing industries can achieve the target of higher competitive capacity in domestic markets and higher export potentiality for foreign markets. To achieve the target, three policy reform scenarios are undertaken to evaluate and suggest a more output, export enhanced and welfare gained policy reform for the Bangladesh economy.

The first scenario (Scenario-1) addresses the shock of 50% tariff reduction in processed food and milled grain imports, which is treated as a policy choice to attain the target. With this scenario it might be possible to know specifically the capacity of competitive behaviour of studied sectors and their export potentiality in opening trade policy. Impact of trade liberalization through CGE model application for the Bangladesh economy has been evaluated in several studies [28, 29, 30, 31, 32]. Most of these studies applied flat tariff cut simulation in all sectors in a given scenario. Therefore, individual or groups of sectors own competitive and adjustment capacity and their share of the contribution on the impact to other sectors and the economy were not identified clearly in these studies. Another shortcoming of these studies are that they concluded by only discussing the impact of trade liberalization on the sector production, resource allocation, household welfare and poverty of the economy, but not by giving any policy reform suggestions for individual sectors to increase their adjustment capacity if this was a deficiency. To rectify some of these shortcomings, this paper undertakes Scenario-1 policy reform for the agro-processing sector to assess adjustment capacity and impact on household welfare.

The second scenario (Scenario-2) inspects the impact of a 5% productivity increase by the agro-processing sector of the economy to gain the study target. The Bangladesh government has given special attention to agribusiness and agri-export through investment to encourage productivity improvement and promotion of export by the agro-processing sector. Maintaining this target, the government has taken the initiative to provide technical education by training for agro-processing technology to improve productivity; offers special financial support for promotion of privatized (local and foreign) investment; offers several trade facilities for export promotion; and improved public facilities, specially for agribusiness industries. All of these initiatives help to increase the productivity directly and indirectly. It this context, it is important to know the impact of increased productivity initiatives on competitive output, encouraging exports, as well as household welfare.

Enhanced output of agro-processing industry can be achieved through increase inputs and TFP. Increased TFP is a combination of improvement of capacity realization (technical efficiency) and technical progress [33]. The factors that increase TFP can be divided mainly by the trade induced and non-trade induced issues. Literature on trade and productivity provide an ambiguous relationship, depending upon the country, industry and the firm. The trade induced TFP increase factor is the technical progress, which is stimulated by increased technology import and spill over effect. The non-trade induced factor for TFP increase is technical efficiency comprised of determinants like human capital development (training, education, health), quality management of infrastructure, financial development, improves management systems of political and economic institutions, research and development, improvement through learning by doing, more privatization, export promotion, foreign investment and absorptive capacity of technology transfer [34]. It is assumed in this study that the exogenous shock of increased TFP is both trade and non-trade induced. As it beyond the capacity of this study to estimate the appropriate level of TFP, the literature has been reviewed to assume the best possible TFP increase percentage of agro-processing industries in Bangladesh.

Single country focused CGE modelling with productivity issue is mostly studied with simulation of increased agricultural productivity [35, 36, 37, 38]. However, there are very few studies which have conducted simulation with productivity increase in the agro-processing sector of a country. Bautista [39] adopted a CGE model to simulate 10% increase TFP in food processing light industries and other manufacturing in the Philippines. Other work conducted by Kinyondo and Mabugu [40] simulated a 1% increase in TFP growth in all sectors of the South African economy. By reviewing the available literature on CGE modelling with TFP increase and empirical growth rate studies of the agro-processing sector of Bangladesh, discussed in section 2, this study finds it appropriate to assume a 5% productivity increase for the agro-processing sector in Scenario-2.

To capture the real world phenomenon, the third scenario (Scenario-3) is constructed with liberalized trade shocks, together with improved productivity. Trade policy reforms of most of the countries in the world are running under a trade liberalization process. Any policy scenario should consider the economy with liberalized trade to make the scenario environment as real as possible. Mabugu and Chitiga [41] simulated this type of combined scenario for South Africa. In this study, the scenario assumes that trade liberalization will ensure a positive effect on increased productivity [42]. Productivity will also increase by the significant major role of non-trade factors. This scenario assumes that the country will liberalize trade policy when they can ensure that there is policy reform to increase productivity capacity at the same time. This scenario also helps to compare the efficiency and extent of impact share of the first two scenarios with this third scenario.

Simulation Results of Scenarios

This section discusses the simulation results of the scenarios. While the scenario simulation results show the impact on all 13 sectors of the economy, only the results of the impact on the agro-processing industry sector are discussed in this section to fulfil the objectives of the study. It is important to keep in mind that the change in factor income, household income, welfare and macro variables are the result of combined impact of the adjustment process of all 13 sectors, not only due to the agro-processing sector adjustment effect.

Scenario -1

Scenario-1 deals with simulation of a 50% tariff reduction on agro-processing sector imports. The simulation results of Scenario-1 are shown in the Table 3 and indicate that the tariff cut reduces the import price and increases imports in both the Johansen and neoclassical closures. In the Johansen closure, prices in the processed food and milled grain sectors decrease by 13.57% and 3.71% respectively. Price reduction encourages increasing import of processed food by 7.99% and milled grain sector by 2.07%. Import price and quantity change is higher in the neoclassical closure compared to the Johansen closure. The rise of export price and quantity of processed food are higher in Johansen case (0.89%, 1.76%) compared to the neoclassical closure. Export increases are mainly due to exchange rate devaluation and fixed trade balance assumptions of closure. Export effect is higher in Johansen closure, because of higher exchange rate devaluation (0.89%) and comparatively lower percentage of transformation into domestic sales. Scenario-1 explains the modest but not satisfactory export potentiality of the processed food sector, because the percentage change of exports is very much lower compared to change in imports.

Table 3. Percentage change of simulation impact of scenarios on trade and consumption.

Trade indicator	Scenario-1		Scenario -2		Scenario -3	
	Johansen	Neoclassical	Johansen	Neoclassical	Johansen	Neoclassical
Export (Qty.)						
Processed Food	1.76	1.10	4.29	2.97	6.15	4.10
Export (Prc.)						
Processed Food	0.89	0.35	0.41	0.03	1.30	0.38
Import (Qty.)						
Processed Food	7.99	8.56	0.11	0.30	8.12	8.89
Milled Grain	2.07	2.55	0.46	0.22	2.55	2.78
Import (Prc.)						
Processed Food	-13.57	-14.03	0.41	0.03	-13.22	-14.01
Milled Grain	-3.71	-4.22	0.41	0.03	-3.32	-4.19
Comp. Commodity (Qty.)						
Processed Food	1.93	2.27	0.75	0.71	2.71	3.02
Milled Grain	0.02	0.11	1.78	0.29	1.78	0.39
Comp. Commodity (Prc.)						
Processed Food	-2.99	-3.15	-0.85	-0.78	-3.85	-3.92
Milled Grain	0.29	0.51	-2.16	-0.09	-1.87	0.41

Source: Simulation results

Table 4. Percentage change of simulation impact of scenarios on production of sectors.

Prod. Variable	Scenario-1		Scenario-2		Scenario-3	
	Johansen	Neoclassical	Johansen	Neoclassical	Johansen	Neoclassical
Dom. Sale (Qty.)						
Processed Food	0.31	0.60	0.93	0.83	1.26	1.44
Milled Grain	-0.05	0.02	1.83	0.29	1.76	0.31
Dom. Supply (Prc.)						
Processed Food	0.16	0.11	-1.22	-1.01	-1.06	-0.91
Milled Grain	0.43	0.68	-2.25	-0.10	-1.81	0.58
Dom. Output (Qty.)						
Processed Food	0.47	0.66	1.31	1.07	1.81	1.74
Milled Grain	-0.05	0.02	1.83	0.29	1.76	0.31
Dom. Output (Prc.)						
Processed Food	0.25	0.13	-1.03	-0.90	-0.80	-0.76
Milled Grain	0.43	0.68	-2.25	-0.10	-1.81	0.58

Source: Simulation results

Scenario-1 simulates that import expansion increases the quantity of composite commodities of both sectors in both the closure groups. The quantity of composite processed food increases by 1.93% in Johansen closure which is lower than neoclassical closure. There is a very minor increase of composite milled grain commodities in Johansen closure (0.02%). This comparatively higher percentage increase in processed food compared to milled grain sector might be partly due to a large fall of composite commodity prices. On the other hand, the lower percentage change of composite milled grain might be due to a very small and even negative change of domestic sales.

Table 5. Percentage change of simulation impact of scenarios on factor demand by all sectors.

Factor	Scenario-1		Scenario-2		Scenario-3	
	Johansen	Neoclassical	Johansen	Neoclassical	Johansen	Neoclassical
Labour						
Non-agricultural Unskilled						
Processed Food	1.13	0.82	-7.26	-3.90	-6.19	-3.10
Milled Grain	-0.32	0.24	-23.18	-4.73	-23.51	-4.52
Non-agricultural Skilled						
Processed Food	0.83	0.62	-6.93	-3.86	-6.13	-3.26
Milled Grain	-0.62	0.04	-22.91	-4.70	-23.46	-4.67
Capital						
Processed Food	0.00	0.59	0.00	-3.61	0.00	-3.04
Milled Grain	0.00	0.01	0.00	-4.46	0.00	-4.45

Source: Simulation results

Changes in imported commodity prices helps to change the prices and quantities of intermediate input, value added and domestic output. The change of domestic output that is reported in Table 4 indicates the competitive capacity of the sectors. In both the closures, the scenario simulates a lower output that illustrates the marginal level of competitive capacity of the agro processing sector. Processed food sector output increases by 0.47% in Johansen closure and 0.66% in neoclassical closure, while milled grain output falls by 0.05% in Johansen case but rises very slightly by 0.02% in neoclassical closure. These trivial contraction and rise of milled grain output indicate very weak propensity to face the challenge of competition with the increased imports due to tariff cuts. The reasons behind negative production of milled grain in Johansen case might be the negative demand of factor use due to fixed demand of capital and investment as per closure rules and comparatively higher increase of intermediate input prices.

Table 6. Percentage change of simulation impact of scenarios on income of factor production.

Factor	Scenario-1		Scenario-2		Scenario-3	
	Johansen	Neoclassical	Johansen	Neoclassical	Johansen	Neoclassical
Labour						
Agricultural Unskilled	0.87	1.35	6.29	1.95	7.17	3.30
Agricultural Skilled	0.85	1.36	5.44	1.83	6.30	3.20
Non-agricultural Unskilled	0.35	0.23	-0.45	-0.06	-0.11	0.17
Non-agricultural Skilled	0.37	0.25	-0.45	-0.04	-0.08	0.20
Land	0.80	1.52	4.67	1.89	5.49	3.43
Capital	0.45	0.29	-1.74	-0.36	-1.30	-0.09

Source: Simulation results

Impact of Scenario-1 on the factor market is presented in Table 5 and shows that the demands for non-agricultural unskilled and skilled labour increase in both the sectors under two closure groups, except the milled grain sector of Johansen case. In processed food sector, the demand for non-agricultural unskilled labour increases by 1.13% (Johansen), 0.82% (neoclassical) and skilled labour increases by 0.83% (Johansen), 0.62% (neoclassical). In the milled grain sector, the demand fall for non-agricultural unskilled and skilled labour by 0.32% and 0.62% respectively in Johansen closure. However, in neoclassical closure, the demand increases for non-agricultural unskilled labour by 0.24% and for skilled labour by 0.04%. Though the capital demand increases by 0.59% in processed food sector and 0.01% in milled grain in neoclassical closure, it remains unchanged in Johansen closure because of fixed demand assumption.

The impacts on factors income are presented in Table 6 and show the allocation adjustment effect on factor return due to change of all sectors demand and supply factors varying upon two different closure cases. Returns to factor rise in both the closure groups. It is identified that non-agricultural labour income and returns to capital are higher in Johansen closure and returns to agricultural labour and land are higher in neoclassical case. The increase of all factors incomes raise the incomes of all household groups and enterprises, which are reported in Table 7. Simulation results show that all three (marginal, small and large) farm household groups earn lower income in Johansen closure compared to neoclassical closure. In both the closures, large farm household income is higher among all household groups. Among the household groups, non-farms, educated, and landless household income changes are higher in Johansen closure, compared to neoclassical closure.

The change of income generates the same change of total expenditure by households. The change of total expenditure combines with the change of consumption expenditure, savings and tax payments to government. The consumption expenditures change through the change of consumption quantities and prices of marketed commodities. The changes of consumption patterns by the different household groups are mixed (rise and fall) in both the closures. The consumption of processed food and milled grain increase in both closure groups. The change of income and consumption help to measure EV to see the changes to household welfare, which is presented in Table 8. Among the household groups, welfare is mixed in the Johansen closure, but all households gain welfare in the neoclassical closure group.

Table 7. Percentage change of simulation impact of scenarios on income of household and enterprise.

Institutions	Scenario-1		Scenario-2		Scenario-3	
	Johansen	Neoclassical	Johansen	Neoclassical	Johansen	Neoclassical
HH Own Landless	0.42	0.35	-0.24	0.03	0.18	0.38
HH Marginal Farm	0.49	0.53	0.60	0.32	1.10	0.85
HH Small Farm	0.56	0.71	1.53	0.64	2.09	1.35
HH Large Farm	0.69	1.08	3.38	1.28	4.08	2.37
HH Non-Farm Poor	0.43	0.37	-0.11	0.08	0.31	0.44
HH Non-Farm Non-Poor	0.43	0.40	-0.54	-0.02	-0.11	0.38
HH Low n Medium Educated	0.40	0.30	-0.20	0.02	0.20	0.32
HH High Educated	0.41	0.33	-0.55	-0.04	-0.14	0.28
Enterprise	0.44	0.28	-1.72	-0.36	-1.28	-0.08

Source: Simulation results

The impacts on macro variables are shown in Table 9. Most of the macro variables reflect expansion of the economy in both the closure groups. Real GDP at market price increases by 0.12% (Johansen) and 0.10% (neoclassical). Real exports and imports increase by 0.95% and 0.57% in Johansen closure and 1.03% and 0.61% respectively in neoclassical closure. Government revenue decreases by 4.45% (Johansen) and 4.88% (neoclassical), mainly due to reduction of tariff income which contributes 50% towards government revenue.

It is observed from the simulation results of tariff cuts in Scenario-1 that the impact of trade liberalization on the competitive capacity level of domestic production is mixed, but moderate in export potentiality. The mixed effect on domestic production indicates that the competitive performance of the processed food industry has medium capacity and the milled grain sector has lesser capacity and even deficient capacity. Additionally, trade liberalization impact shows increases of macro variables such as real GDP, trade and absorption.

Scenario -2

Scenario-2 simulates a 5% productivity increase for the processed food and milled grain industries. The scenario firstly introduces a shock to production activity by increasing total factor productivity (TFP). This shock adjusts the allocation of resources through reducing the factor demand, which consequently reduces the value added cost at the industry activity level. Results show that the current simulation increases the value added and domestic production of both the sectors (Table 4). Domestic production increases in the processed food industry by 1.31% in Johansen closure and 1.07% in neoclassical closure. Milled grain sector also generates a rise in domestic production by 1.83% in Johansen closure and 0.29% in neoclassical closure. Increased productivity raises the domestic sales of the processed food industry by 0.93% (Johansen) and 0.83% (neoclassical); and milled grain sector industry by 1.83% (Johansen) and 0.29% (neoclassical).

Table 8. Percentage change of simulation impact of scenarios on household welfare.

Institutions	Scenario-1		Scenario-2		Scenario-3	
	Johansen	Neoclassical	Johansen	Neoclassical	Johansen	Neoclassical
HH Own Landless	0.4	0.3	-0.1	0	0.2	0.4
HH Marginal Farm	0.4	0.5	0.7	0.3	1	0.8
HH Small Farm	0.4	0.7	1.6	0.6	1.9	1.3
HH Large Farm	-0.2	1	3.4	1.3	3.2	2.3
HH Non-Farm Poor	0.2	0.4	0	0.1	0.2	0.4
HH Non-Farm Non-Poor	0.3	0.3	-0.5	0	-0.2	0.3
HH Low & Medium Educated	0.3	0.3	-0.2	0.1	0.1	0.4
HH High Educated	-0.5	0.4	-0.6	0	-1.2	0.3

Source: Simulation results

Simulation results reported in Table 3 indicate that the impact on trade is encouraging due to increase exports. Rises in domestic output transform into domestic sales and subsequently exports. Export of processed food increases by 4.29% in Johansen closure and 2.97% in neoclassical closure. The simulation in Scenario-2 reveals that raising productivity strongly helps to increase export potentiality through stimulating domestic production.

The TFP increase generates foremost effect in the factor market through reducing their demand. Changes in factor market behaviour is also significantly influenced by the different market clearing conditions of closure rules. Table 5 represents a fall in demand for non-agricultural unskilled and skilled labour in the processed food sector by 7.26% and 6.93% respectively in Johansen case, which are higher than neoclassical closure. In milled grain sector, a larger fall of demand for non-agricultural unskilled labour (23.18%) and skilled labour (22.91%) is observed in Johansen closure compared to neoclassical closure. Moreover, due to factor market assumptions in Johansen closure the simulation generates a fall of supply (wage fixed) of non-agricultural unskilled labour and reducing wages (fixed supply) of non-agricultural skilled labour. In the capital market, when demand and supply are fixed, there is large fall in the rent of capital which helps to considerably reduce the value added cost in Johansen closure.

Both the closure groups show same trend of effects on the factor income but degree of change is higher in Johansen closure compared to neoclassical closure simulation (Table 6). The highly reduced demand for factors of production in the agro-processing sector consequently generates factor migration to other sectors to maintain full employment in the economy. As a result, mixed change of factor demand by all sectors jointly generates a mixed wage and income effect on factors of production. Similarly, the incomes of non-agricultural (unskilled and skilled) labour and capital also fall, because of the decreased demand for these factors due to increased productivity of the agro-processing sector. The mixed effect on factor income largely generates mixed income change among the household groups and enterprises in both closure groups (Table 7). Income falls mostly in those household groups who have a large income share of non-agricultural labour and capital. The income rises mostly for those household groups who have a large share of income sourced from agricultural labour and land.

Changes in household income consequently generates a mixed change in the consumption expenditure of composite commodities through maintaining the maximum level of utility. The consumption of both the composite processed food and milled grain are increased by all household groups in both the closures. The increased consumption of these two sectors might be due to increased production and fall of market price. The mixed change of income and consumption of all sectors stimulate the mixed welfare effect on household groups. The results of household welfare

through measuring EV (Table 8) indicate that welfare gain is mixed among the household groups in Johansen closure, but positive and no change among the household groups in neoclassical closure.

Table 9. Percentage change of simulation impact of scenarios on macro indicators of economy.

Macro Variable	Scenario-1		Scenario-2		Scenario-3	
	Johansen	Neoclassical	Johansen	Neoclassical	Johansen	Neoclassical
Absorption	0.11	0.09	0.11	0.20	0.22	0.29
Private Consumption	0.15	0.44	0.15	0.17	0.31	0.61
Investment	0.00	-1.05	0.00	0.32	0.00	-0.74
Export	0.95	1.03	0.28	0.47	1.24	1.50
Import	0.57	0.61	0.17	0.28	0.74	0.89
GDP Mkt Price	0.12	0.10	0.12	0.21	0.24	0.31
Net Tax	1.01	0.98	0.19	0.32	1.20	1.31
GDP Factor cost	0.07	0.05	0.12	0.21	0.19	0.25
Govt income	-4.45	-4.88	0.40	0.24	-4.08	-4.66
Govt expenditure	0.13	0.11	0.00	-0.06	0.13	0.04
Govt savings	8.00	8.67	-0.69	-0.57	7.35	8.13
Exchange Rate	0.89	0.35	0.41	0.03	1.30	0.38

Source: Simulation results

The total factor productivity change through this scenario consequently shows positive effect on the aggregate macro variables of the economy (Table 9). Increased productivity raises the real GDP at market prices by 0.12% in Johansen closure and 0.21% in neoclassical closure. Real exports and real imports increase in Johansen closure by 0.28% and 0.17%; and in neoclassical closure 0.47% and 0.28% respectively. Through increasing consumption and investment the real absorption increases in both the closures under the scenario.

The results of Scenario-2 demonstrate that increasing TFP in the agro-processing sector substantially stimulates an increase in domestic production and export. However, it also generates a fall in factors income and as well as household income, which also creates welfare loss to some of the household groups. Despite of mixed effect on welfare, the macro impact of this scenario shows positive effect on real GDP, trade and absorption.

Scenario-3

Scenario-3 runs the simulation in a combination of scenarios one and two together. Simulation results (Table 3) reported that shocks to the scenario causes a substantial import increase of processed food by 8.12% and milled grain by 2.55% in Johansen case, which are lower than neoclassical case. Scenario-3 simulates a higher increase in domestic production of processed food and milled grain by 1.81% and 1.76% in Johansen closure compared to neoclassical closure (Table 4). This scenario ensures that competitive capacity of domestic production becomes stronger when liberalizing trade with increased TFP. The large contribution of the increased domestic output by TFP increase and exchange rate devaluation effected largely by tariff cut shock, jointly expand the export of processed food by 6.15% in Johansen closure (Table 3). This significant expansion in export indicates that the combination of increased productivity and liberalized trade jointly generate higher exports for the processed food sector.

Impact of Scenario-3 on the allocation of factor demand shows that the demand for labour and capital fall in both the sectors in two closures largely due to increased factor productivity shocks (Table 5). Simulation impacts on factor demand of the rest of sectors are mixed, which generate different magnitudes of change in the income of each factor. Income increases in agricultural labour

groups and decreases in non-agricultural labour groups and capital in Johansen closure, but most of the factors income increase in neoclassical closure except the returns to capital (Table 6).

Together with the change of factor income and transfer from other non-government institutions, the simulation results provide a mixed effect on household and enterprise income (Table 7). Because of the large increase of returns to land and agricultural labour, the income of all farm household groups are higher than other household groups in both closures. The income fall of some household groups might be partially due to a large fall of factor income of non-agricultural labour and capital. The change of household income also corresponds to a mixed change of total expenditure of households. The changes of composite commodity consumption by the household groups are mixed. Changes of income and consumption expenditure due to price adjustment help to evaluate the household welfare effect on the economy. Except for the loss of welfare of non-farm non-poor households and high educated households, the rest of all household groups attain positive welfare in the Johansen closure (Table 8). The welfare gain is observed in all the household groups in neoclassical closure.

Impact on the macro indicators is shown in an expanding economy under Scenario-3 (Table 9). The simulation generates an increase of real GDP at market prices, real exports and real imports. The overall picture of simulation shows that trade liberalization and increased productivity jointly boost the competitive capability of the agro-processing sector in the domestic market, as well as the export potentiality of an export oriented food processing sector. The scenario also produces increased income and welfare in most of the household group's, as well as most of the macro economic variables.

Evaluation of Results for Best Policy Choice

Evaluation of all the scenarios aims to compare the results of three simulations to ascertain the best policy choice for the prospective future of the agro-processing sector and the economy as a whole. The policy simulations offer choice among the closure rules, trade liberalization, productivity increase and a combination of increased productivity with trade liberalization. Comparing the impact of the various scenarios, it is observed that both the increased percentage of imports and exports are higher in the third scenario. Comparing between the closure rules of the third scenario, it is found that exports in the Johansen closure are higher. Comparing the three scenarios, it is apparent that trade liberalization policy initiatives are vindicated resulting in increased exports when a TFP increase initiative prevails at the same time.

Comparing the scenarios to increase competitiveness in domestic production, it is found that the third scenario shows the highest impact on domestic production, domestic sales and composite commodity consumption. The competitiveness of the sector is considered by the level of percentage change in domestic production. It is observed that the competitiveness of the processed food sector is very low in first scenario, moderate in the second scenario and very high in the third scenario. However, milled grain shows a different impact on domestic production among the scenarios. Adjustment capacity of domestic production is very minor and even negative in the first scenario, which indicates very weak competitiveness under a trade liberalized market. This weakness is removed in third scenario. It is also found in the third scenario that increased domestic production is higher in Johansen closure compared to neoclassical closure. Evaluation of domestic production capacity helps to understand that if the trade liberalization reduces the competitive capacity of industry, it is possible to increase that capacity by increased productivity.

Comparing the impact on factor income, household income and welfare, it is observed that the first scenario generates positive impact in most of the variables, while the second scenario generates mixed effects among the variables. Finally, the third scenario generates mostly moderate effects on

all the variables, especially through removing the negative effect of the second scenario. Between the closures of the third scenario, it is observed that changes in income and welfare are mixed but mostly higher in Johansen closure compared to neoclassical closure simulation. In the light of the above discussion, this study revealed the best policy reform option which demonstrates that trade liberalization with increased TFP can help to strengthen the economy through increased exports and competitiveness of the agro-processing sector in international and national markets.

This study uses sensitivity analysis to assess the results of scenarios by using the two different closure assumption groups. It is identified that the results of individual scenarios vary between Johansen and neoclassical closure groups. Comparing the closure groups for the sensitivity of the results, it can be stated that the short run type of closure assumption (Johansen closure) provides mixed (gain and loss) welfare and long run type of closure assumption (neoclassical) shows welfare gain among the household groups under trade liberalization with increased productivity policy reform. The results of the Johansen closure are more relevant considering the character of the static model and economy of Bangladesh. By evaluating the sensitivity of the results this study also ensures that the results of CGE model analysis differ due to the use of different closure rule assumptions.

Concluding Remarks and Policy Implications

This study makes it possible to envisage the future of the agro-processing sector in Bangladesh by assessing the impact of different policy reform simulations. The point of departure of this work is to confront a CGE model with comparative static assumption to evaluate and quantify with sensitivity the economy wide impact of three policy reform scenarios. The scenarios are associated with opening trade and improving productivity of the processed food sector and milled grain sector. This work suggests the best policy reform choices to reach the focused aim of increased domestic production, enhanced competitive capacity and increased export potential.

The results of the policy reform simulations show different magnitudes of impact of the three scenarios. The impact of the first scenario provides for a mixed effect on production, slightly increase of exports and moderate increase of household income and welfare. The impact of the second scenario provides for a potential increase in production and exports, but highly mixed effects on household income and welfare. Finally, the impact of the third scenario on increased output and exports is significantly high and household income and welfare increases are mixed but favourable. Comparing the scenarios, this study finds that the impact of unilateral tariff reduction trade liberalization on the economy might be positive but in itself alone is not enough for increasing exports and competitiveness. On the other hand, the impact of increased productivity alone might have potential for increased output and exports, but not enough to gain economy wide income and welfare. So the best suggested policy choice is unilateral trade liberalization with an ensured increase in productivity through trade and non-trade induced factors to manage efficiently the challenge of competition, to increase the export potential of the agro-processing sector and to gain welfare.

From the policy perspective, it is identified that the agro-processing sector has high export potential as the country has an agro-based economy, low cost production facilities, i.e. cheap labour and cheap locally supplied intermediate inputs and natural resources. But it is also important for the policy makers to appreciate the best choice of policy initiative to increase the prospect of exports, as well as domestic production possibilities when the country has a greater trade liberalization policy. This study concluded that trade liberalization will help to generate export potential and domestic sector competitiveness if increased productivity is ensured through factors such as technological progress through increased import of technology and by the non-trade factors such as improved technical efficiency through enhanced quality, management and knowledge etc.

Although it has been identified that trade liberalization increases the productivity that comes from importation of technology and competitive push, these have only a partial impact on productivity increase and are not a sufficient and complete initiative. As Bangladesh is a net food importing country, so trade liberalization mostly helps to increase import of food compared to technology. In addition, efficient knowledge and a proper utilization environment for new technology are also important issues for a country like Bangladesh. Increased technology import alone is not enough for increased productivity unless the country has the adaptive capacity and knowledge for efficient utilization of imported technology. Import of technology will not be fully effective until the non-trade induced TFP factors are improved and create a supportive environment to maximise the benefits of imported technology. Considering this, any policy formation should give emphasis to improving the non-trade factors of increased productivity. Improvement of the human capital development through education and training and the management quality of institutions and the financial system can be more direct and immediate initiatives. Also, modern policy reform should initiate increased private and joint venture foreign investment, which will provide greater encouragment to improve productivity.

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