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A General Equilibrium Analysis on the Impact of Tariff Reforms to Protect Agricultural Sector in Bangladesh

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Abstract

This paper examines the impact of tariff reforms of the agricultural sector in Bangladesh to protect domestic agriculture using the social accounting matrix (SAM) obtained from the Global Trade Analysis Project (GTAP) database. The computable general equilibrium (CGE) model is employed to investigate the impact of tariff reforms on the agricultural sector in Bangladesh. The CGE model is used to assess the impact of economic shocks that reverberate across sectors and represent cumulative shocks across the country. The CGE model is calibrated to a social accounting matrix (SAM) obtained from the GTAP 8 database after integrating 57 sectors into 4 sectors, a consistent, complete and disaggregated data system. Hicksian Equivalent Variation (EV) is computed which measures the changes in the utility level in monetary terms of the total households of Bangladesh in Household income and Expenditure Survey 2010. All other 146 member countries of WTO are considered as the rest of the world and assuming that import tariff rates of these countries are set according to WTO norms and other guidelines. The simulation results show that the trade reforms would improve the welfare of Bangladesh. The results suggest that the agricultural sector would expand with these trade reforms whereas service and mineral sectors would contract. So, the government should protect this agricultural sector by reforming import tariffs to ensure food security that would lead to reduced poverty.

Keywords: Computable general equilibrium; Tariff reforms; GTAP; Agriculture sector; Welfare; Social accounting matrix.

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Introduction

Agricultural trade liberalization and its impact on developing economies have long been issues of contention in international trade negotiations. Small economies dependent on food imports would be harmed by rising agricultural prices, and that changes in world prices could have adverse effects on food security and poverty. By contrast, comprehensive agricultural trade reform in developed countries tends to benefit most economies, and consistently lowers poverty (Gilbert, 2008). Using computable general equilibrium model Pradhan and Sahoo (2008), on the other hand, finds that a cut in tariffs leads to a decrease in overall welfare and reduction in poverty. Hertel, Keeney, Ivanic, and Winters (2007) also find that agricultural trade liberalization would reduce poverty. Mujeri and Khondker, 2002 observe that Bangladesh economy becomes significantly outward-oriented because of quantitative changes in tariff and removal of non-tariff barriers. They also observe that Bangladesh takes the liberalized policy intending to reduce economic distortions and welfare losses resulting from the trade policy.

Agriculture is the single most important sector of Bangladesh economy contributing 13.32% to its GDP (BBS, 2020). It is the major source of employment and livelihood in rural areas. Approximately two-thirds of the total labour force is engaged in agriculture. Despite the declining relative share in GDP, agriculture continues to remain the major sector in terms of employment and agriculture (crops, livestock, fisheries and forestry) contributes approximately one-third of the GDP and agricultural production accounts for 32 per cent of the value of exports. Economic growth largely depends on the performance of this sector. But little information is known from past research about the consequences of tariff reform of agricultural sectors in Bangladesh. To address the above gap, the present study provides a new look at the impact of tariff reform on agricultural sectors in Bangladesh. In doing so, a CGE model is developed and observed the trade policy simulations for Bangladesh using the social accounting matrix from the GTAP database. Three scenarios one after the abolition of tariff rates, subsequently 10% import tariff are observed, and finally, 10% tariff rate only one agricultural sector is applied. I found that liberal trade policy of abolition of import tariff leads to an increase in the household welfare, however imposing 10% tariff only on agricultural sectors to protect domestic agriculture is considered to be effective too. In this case, though the welfare is a little bit lower than zero tariffs, however, it provides much more welfare than the baseline scenario and as well as gives revenue to the government. Overall, by this policy domestic agriculture boosts as the output of the agricultural sector increases and imports of agricultural goods reduce significantly which lead to a decline in the price of agricultural output.

Methodology and Model

The CGE model consists of 279 single equations and an equal number of endogenous single variables that are divided into prices, sectors of the population, factors of production and utility function. CGE model is used to assess the impact of economic shocks that reverberate across sectors and represent cumulative shock across the country. CGE model is calibrated to a social accounting matrix (SAM) obtained from GTAP 8 database after integrating 57 sectors into 4 sectors, which is a consistent, complete and disaggregated data system.

This model consists of 4 goods and 4 factors of production with the assumption that all factors (land, unskilled labour, skilled labour, and capital) available are completely used by 11

sectors. Hicksian Equivalent Variation (EV) is computed which measures the changes in the utility level in monetary terms of the total households of Bangladesh in Household income and Expenditure Survey 2010. All other 146 member countries of WTO are considered as rest of the world and assuming that import tariff rates of these countries are set according to WTO norms and other guidelines.

The following systems of simultaneous equations of different blocks for the standard CGE model (Hosoe, Gasawa, & Hashimoto, 2010) are solved using GAMS ad optimal as well as equilibrium solutions are analyzed.

Domestic Production Block:

$$y_j = b_j \prod_h F_{h,j}^{\beta h,j} \quad \forall j \text{ .....} \quad (1)$$

$$F_{h,j} = \frac{\beta h,j \; pj^y}{P_h^f} Yj \quad \forall h,j \text{ .....} \quad (2)$$

$$X_{i,j} = ax_{i,jzj} \quad \forall i,j \text{ .....} \quad (3)$$

$$Y_j = ay_i Z_j \quad \forall j \text{ .....} \quad (4)$$

$$P_j^z = ay_j P_j^y + \sum_i a\, x_{i,j} p_i^q \quad \forall j \text{ .....} \quad (5)$$

Government Block:

$$T^d = \tau^d + \sum_h P_h^f FF_h \text{ .....} \quad (6)$$

$$T_j^z = \tau_j^z p_j^z Z_j \quad \forall j \text{ .....} \quad (7)$$

$$T_i^m = \tau_i^m p_i^m M_i \quad \forall j \text{.....} \quad (8)$$

$$X_i^g = \frac{\mu i}{p_i^q} (T^d + \sum_j T_j^z + \sum_j T_j^m - S^g) \quad \forall j \text{.....} \quad (9)$$

Investment and Saving Block:

$$X_i^v = \frac{\lambda i}{p_i^q} (S^p + S^g + \in S^f) \quad \forall i \text{ .....} \quad (10)$$

$$S^p = ss^p (\sum_h P_h^f FF_h) \text{ .....} \quad (11)$$

$$S^g = ss^g (T^d + \sum_j T_j^z + \sum_j T_j^m) \text{ .....} \quad (12)$$

Household Block:

$$X_i^p = \frac{\alpha i}{p_i^q} \left(\sum_h P_h^f FF_h\right) - S^p - T^d) \quad \forall i \text{.....} \quad (13)$$

Export and Import Prices and Balance of Payments (BOP) Block:

$$P_i^e = \in P_i^{We} \quad \forall i \text{ .....} \quad (14)$$

$$P_i^m = \in P_i^{Wm} \quad \forall i \text{ .....} \quad (15)$$

$$\sum_j P_i^{We} E_i + S^f = \sum_j P_i^{Wm} M_i \text{ .....} \quad (16)$$

Armington Composite (Substitution between imports and domestic goods) Block:

$$Q_i=\gamma_i\left(\delta mi M_i^{\eta i}+\delta di D_i^{\eta i}\right)^{\frac{1}{\eta i}} \quad \forall i \text{ .....} \quad (17)$$

$$M_i=\left[\frac{\gamma_i^{\eta i}\delta mi p_i^q}{(1+\tau_j^m)p_i^m}\right]^{\frac{1}{1-\eta i}} Q_i \quad \forall i \text{ .....} \quad (18)$$

$$D_i=\left[\frac{\gamma_i^{\eta i}\delta di p_i^q}{p_i^d}\right]^{\frac{1}{1-\eta i}} Q_i \quad \forall i \text{ .....} \quad (19)$$

Transformation between exports and domestic goods block:

$$Z_i=\theta_i\left(\xi ei E_i^{\emptyset i}+\xi di D_i^{\emptyset i}\right)^{\frac{1}{\emptyset i}} \quad \forall i \text{ .....} \quad (20)$$

$$E_i=\left[\frac{\theta_i^{\emptyset i}\xi ei(1+\tau_i^z p_i^z)}{p_i^e}\right]^{\frac{1}{1-\emptyset i}} Z_i \quad \forall i \text{ .....} \quad (21)$$

$$D_i=\left[\frac{\theta_i^{\emptyset i}\xi di(1+\tau_i^z p_i^z)}{p_i^d}\right]^{\frac{1}{1-\emptyset i}} Z_i \quad \forall i \text{ .....} \quad (22)$$

Market Clearing Conditions:

$$Q_i=X_i^p+X_i^g+X_i^v+\sum_j X_{ij} \quad \forall i \text{ .....} \quad (23)$$

$$\sum_j F_{hj}=FF_h \quad \forall h \text{ .....} \quad (24)$$

The endogenous variables in this model are: Y_j, $F_{h,j}$, $X_{i,j}$, Z_j, X_i^p, X_i^g, X_i^v, E_i, M_i, Q_i, D_i, P_h^f, P_j^y, P_j^z, P_i^q, P_i^e, P_i^m, P_i^d, ϵ, S^p, S^g, T^d, T_j^z and T_j^m

The exogenous variables are: FF_h, S^f, P_i^{We},P_i^{Wm}, τ^d, τ_j^z, τ_i^m

Where, Y_j= Composite factor produced.

$F_{h,j}$ = The h-th factor used by the j-th firm,

$X_{i,j}$ = Intermediate input of the i-th good used by j-th firm,

Z_j = Gross domestic output of the i-th good used by the j-th firm,

X_i^p = Household consumption of the i-th good,

X_i^g = Government consumption of the i-th good,

X_i^v = demand for the i-th investment good,

E_i = Exports of the i-th good,

M_i = Imports of the i-th good,

Q_i = The i-th Armington composite good,

D_i = The i-th domestic good,

P_h^f = Price of the h-th factor,

P_j^y = Price of the j-th composite factor

P_j^Z = Price of the j-th gross domestic output.

P_i^q = Price of the i-th composite good.

P_i^e = Export price in terms of domestic currency,

P_i^m = Import price in terms of domestic currency,

P_i^d = Price of the i-th domestic good,

ϵ = Foreign exchange rate (domestic currency/ foreign currency)

S^p = Household saving,

S^g = Government saving

T^d = Direct tax,

T_j^z = Production tax on the j-th good,

T_i^m = Import tariff on the i-th good,

FF_h = Endowments of the h-th factor for the household,

S^f = Foreign saving,

P_i^{We} = Export price in terms of foreign currency,

P_i^{Wm} = Import price in terms of domestic currency,

τ^d = Direct tax rate,

τ_j^z = Production tax rate on the j-th good,

τ_i^m = Import tariff rate on the i-th good,

$\propto_I$ = Share parameter of the utility function,

$\beta_{h,j}$ = Share coefficient in the composite factor production function,

b_j = scaling coefficient in the composite in the composite factor production function,

$ax_{i,j}$ = input requirement coefficient of the i-th intermediate input for a unit output of the j-th good,

a_{yj} = input requirement coefficient of the j-th composite good for a unit output of the j-th good,

λi = Expenditure share of the i-th good in total investment ($\sum \lambda i = 1$),

μi = Share of i-th good in government expenditure ($\sum \mu i = 1$),

γi = Scaling coefficient in the Armington composite good production function,

σi = Elasticity of substitution in the Armington composite good production function,

ηi = Parameter defined by the elasticity of substitution, ($\eta i = (\sigma i - 1)/\sigma i$), ($\eta i \geq 1$),

θi = Scaling coefficient of the i-th transformation,

ξei, ξdi = Share coefficient of the i-th good transformation, ($\xi ei + \xi di = 1$,

ψi = Elasticity of transformation of the i-th good transformation,

ϕi = Parameter defined by the elasticity of transformation$(\phi i = (\psi i + 1)/\psi i, \psi i \geq 1$

The simulation was carried out in three scenarios: (1) abolition of import tariff, (2) imposing 10% tariff rates on all four sectors, and (3) imposing 10% tariff rates only in no agriculture sectors. The sensitivity analysis is done by changing the sectors elasticity of substitution and transformation in low elasticity case (decrease by 25% of the values of the elasticity obtained by imposing only 10% tariff rates on agricultural sectors to protect domestic agriculture) and high elasticity case (increase by 25% of that values of the elasticity).

Table 1: Baseline Scenario of Household Consumption, Export and Import Share as % of Output

Sectors	Consumption as % of Output	Export as % of Output	Import as % of Output	Import tariff rate	Elasticity
Agriculture	42.85	1.41	10.72	4.7%	2
Mineral	17.73	0.19	40.52	5.3%	2
Manufacturing	42.00	24.97	30.53	12.3%	2
Service	32.64	2.73	1.83	-	2

Results and Discussion

The SAM entries obtained from the GTAP 8 database for Bangladesh based on the Macroeconomic situation of 2007 and the SAM table indicates that the base run import tariff rates (τ_i^m) are 4.7% for agriculture, 5.3% for minerals, and 12.3% for manufacturing even after the implementation of liberal trade policies. Hence, the impacts of liberal trade policies are examined using three counterfactual equilibrium solutions obtains by imposing a zero-tariff scenario, imposing a 10% flat tariff rate for all sectors and imposing 10% tariff rates only on the agricultural sector to protect domestic agriculture. The following table 2 depicts the counterfactual scenario of abolishing import tariff rates.

It is clearly seen that the abolition of the import tariff rate has a positive impact on agricultural sectors, output increases, price decreases export, and import increases too (Table 2). However, it hurts service sectors as output declines by 1.02%. However, exports increase for all sectors and import of manufacturing sector increase markedly. On the other hand, import of service sectors decreases compare to a base run scenario. The consumptions of manufacturing goods increase under this scenario. The increase in exports for all sectors may be due to the reduction of tariff rates in the rest of the world.

Table 2: Simulation results for % change from the Baseline values of Household Consumption, Output, Export, and Import from the Baseline for import tariff set at 0% in all sectors

Sectors	Consumption(dXp)	Output(dZ)	Price (dpz)	Export(dE)	Import(dM)
Agriculture	1.16	1.59	-0.91	7.84	4.74
Mineral	1.52	0.18	-1.02	6.59	4.38
Manufacturing	6.11	3.01	-2.44	12.82	10.99
Service	1.23	-1.02	-1.13	5.55	-7.53

Table 3: Simulation results for % change in Household Consumption, Output, Export and Import from the Baseline for import tariff set at 10% in all sectors

Sectors	Consumption(dXp)	Output(dZ)	Price (dpz)	Export(dE)	Import(dM)
Agriculture	-0.54	0.31	0.10	0.28	-9.09
Mineral	-0.82	1.30	-0.05	1.57	-7.41
Manufacturing	0.72	-1.11	-0.03	-0.88	2.71
Service	-0.11	0.14	-0.02	0.36	-17.43

Table 4: Simulation results for % change in Household Consumption, Output, Export and Import from the Baseline for import tariff set at 10% in agricultural sector and 0% in rest of the sectors

Sectors	Consumption(dXp)	Output(dZ)	Price (dpz)	Export(dE)	Import(dM)
Agriculture	-0.10	2.36	-0.46	7.60	-11.91
Mineral	1.52	-0.43	-0.96	5.71	3.98
Manufacturing	5.67	1.61	-1.98	10.14	11.55
Service	1.16	-0.88	-1.02	5.38	-7.09

The policy of flat tariff rates has a positive effect on the agricultural sector too, as output increases and imports decrease as it is intended (Table 3). However, this policy hurts manufacturing sectors as output declines by 1.11%. Imports decrease in all sectors except manufacturing sectors. It also affects the consumption of these sectors.

On the other hand, the policy of imposing 10% tariff rates only on the agriculture sector, to protect the agricultural sector, hurts the import of agricultural products as import decreases by 11.91% leading to a decline in the price of agricultural output (table 4) that is the policy objective of this model. The output of the agricultural sector increases that means the agricultural sector becomes expand even than that of the other two policy options. Moreover, the export of all the sectors increases by this policy that indicates a positive current account balance.

The social welfare as measured by Hicksian equivalent variation is higher (1584.252) in scenario one with zero tariff rate of all the sectors than that of scenario two (121.303). Social welfare also increases in scenario three (1382.408), however less than that of scenario one. But in this case, the government earns moderate revenue (as Tm is 210.133) by imposing a tariff that can be used for public purposes to increase welfare.

Robustness of the Simulation Results

The robustness of the simulated results is examined under the criteria that how sensitive the estimated results are with the change in sectoral elasticity to maintain the sign and order of the change of sectoral output, price, consumption, export and import respectively in all three cases. The sectoral output, price, consumption, export and import change under base run (2.0), low (25% decreases i.e., 1.5) and high (25% increases i.e., 2.5) elasticity cases (Table 5).

Table 5: Sensitivity Analysis

Sectors	Agriculture	Mineral	Manufacturing	Service	Elasticity
	-0.999	1.480	5.616	1.138	1.5
Consumption(dXp)	-0.104	1.520	5.688	1.164	2.0
	-0.109	1.555	5.758	1.189	2.5
	2.146	-0.048	1.979	-0.918	1.5
Output(dZ)	2.357	-0.429	1.612	-0.876	2.0
	2.555	-0.808	1.253	-0.832	2.5
	-0.500	-0.941	-1.959	-1.009	1.5
Price(dpz)	-0.463	-0.956	-1.977	-1.022	2.0
	-0.429	-0.971	-1.995	-1.034	2.5
	6.204	4.617	8.406	3.813	1.5
Export(dE)	7.599	5.714	10.142	5.380	2.0
	8.947	6.822	11.914	6.967	2.5
	-8.870	3.181	9.310	-5.688	1.5
Import(dM)	-11.910	3.982	11.548	-7.090	2.0
	-14.819	4.793	13.794	-8.468	2.5

It is depicted that the 4 sectors showed a similar change in sign (either positive or negative) with the change in elasticity (Table 5). For example, agriculture sectors show positive percentage change for lower, base run and higher elasticity. The same is true for other sectors. The percentage changes in production also follow the order with the change in the value of sigma and psi, so they fulfil both the criteria of robustness. While analyzing the changes in consumption (dXp) and price (dpz), it is observed that both the above-mentioned criteria are applicable for them too. Therefore, it is concluded that the proposed model can be considered to have robustness.

These results show that the consumptions of all sectors increase when zero tariffs are set and the output of all sectors increase except the service sector. The price of the output of all sectors decreases and export of all sectors increases, import of all sectors increased too except service sector. Whereas, consumption of all sectors except agricultural sectors increases too when a 10% import tariff is imposed only one agricultural sector. The price of all sectors decreases and the export of all sectors increases, implying that demand for domestic goods in the foreign market increases.

The import of agricultural goods decreases which leads to a decrease in the domestic price of agricultural commodities. The output of agricultural goods increases which implies that domestic agriculture expands.

Conclusion

Simulation results indicate that with the reduction of import tariff rates the household welfare of Bangladesh had increased. The abolition of the import tariff rate on all sectors had increased the consumption of all sectors. Export of all sectors increased even though there was a decrease in output of service sectors. The welfare also increased when the tariff was imposed only on agricultural sectors, import of agricultural goods decreased significantly leading to a decline in output price that was the policy objective of this model. Moreover, by introducing this policy output of agricultural sectors increased compared to two other policy options which indicated that the domestic agriculture sector boosted and became expand as well. Finally, both the policies (zero tariff rates and 10% tariff rates only on agriculture sector) were considered as pro-poor as in both cases welfare increase.

As it is mentioned in the introduction that agriculture is the single most important sector in Bangladesh. So, the government should protect this sector by reforming import tariffs to ensure food security that would lead to reduce poverty. As Bangladesh is the way of achieving self-sufficiency in agriculture, hence, therefore, this paper may help the policymakers in planning the future course of action.

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